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# THE GEOLOGICAL-AGES HOAX
## *A PLEA FOR LOGIC IN THEORETICAL GEOLOGY*

## *By* GEORGE McCREADY PRICE

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# THE GEOLOGICAL-AGES HOAX

## *A PLEA FOR LOGIC IN THEORETICAL GEOLOGY*

By

GEORGE McCREADY PRICE 1870-

> *"If science is not to degenerate into a medley of* ad hoc *hypotheses, it must become philosophical and must enter into a thorough criticism of its own foundations."*
>
> A. N. WHITEHEAD
> *Science and the Modern World, Page 25*

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# PREFACE

EACH of the natural sciences has three aspects. There is first the heuristic or the investigatory aspect, concerned chiefly with the discovery of new facts. Secondly, we have the speculative aspect, under which an effort is made to bring the facts into relationship with the facts already known either in the same science or in others. The third aspect is the critical, when the searchlight of logic and correct scientific method is turned upon the speculative theories which have been propounded to " account for " or to " explain " the facts. When all three aspects develop *pari passu* the science may be said to be in a healthy condition.

During recent years a great plethora of facts has been accumulating in all the sciences. But because of the growing habit of narrow specialization, the theories which have been adopted to correlate these discoveries with those already known have in many instances been only short-term or makeshift theories, merely bringing these new facts into relationship with the long-established doctrines in their respective sciences. In none of the natural sciences except theoretical physics has there been any serious attempt to overhaul the foundations, so as to bring the basic principles of the science into line with the new discoveries. In almost all of the sciences the third aspect, the critical, has been very slowly and very painfully developed, and in geology at least this aspect may be said to be nonexistent.

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J. H. Woodger, of London University, in his remarkable book, *Biological Principles* (1929), expresses the general situation as follows:

> " Modern natural science may be likened unto a crab which has grown too fat for its shell. The process of ecdysis [moulting] is slow and painful. The old shell, which has matured and hardened for some three hundred years, has done good service. No wonder the crab is loath to part with it. But it has already begun to crack, and some bits have even dropped off. What is to be done? Should the crab go on getting fat and take no thought for the raiment of the morrow? Or should it resolutely face the situation, heave off the remains of the old shell with a sigh, and set about making a new one in earnest? There is a good deal of uncertainty about the precise form and texture of the new shell. But the evil day cannot be delayed much longer, and if it is put off too long the process of growth may suffer, or the whole may fall to pieces for lack of support."

Everybody knows that physics has recently been moulting. Chemistry seems about ready for its ecdysis, whenever physics grows its new shell, and thus demonstrates the best method of performing this painful and somewhat dangerous process.

About three-quarters of a century ago, under the stimulating diet supplied by the mid-Victorian scientists, biology and the related sciences all moulted at the same time, putting on very similar new coverings which seemed much prettier and more comfortable than the old ones. In this respect they were following the example set by geology about twenty-five years earlier (or about a hundred years ago now); for the nice new shell which geology had developed had made the other sciences very jealous; so they all decided to throw off their old coverings and adopt the new style set by geology. Since then all of these sciences have been getting fatter and fatter, as they have fed on the very liberal diet of new facts; but all alike have refused to show any tendency toward another moult. In this respect all of these sciences seem to be again watching geology; and although the old shell of the latter has become very tense and rigid, it has hitherto shown not the slightest tendency toward replacing its old shell with a new one. It is alarming to think what may happen if this rigid shell, now a hundred years old, is not cast very soon.

The following pages are an effort to assist at the ecdysis of geology. Under the present circumstances it would seem that a major surgical operation may be necessary, since it is evident that the old shell is so hard and unyielding that it will have to be ripped open in order to begin the work of casting it off.

This book is devoted to just one idea. It is a criticism of the claims of geologists that they are able to differentiate the fossils into groups or sets which have definite time-values of world significance.

Locally, of course, one can always read time-values from any vertical section of exposed strata. It has long been thought that by ingenious comparisons from here and there, and by assembling type-sections from various localities all over the globe, a real chronology for the world could be made out. A very elaborate scheme of this sort has long been in vogue and is popularly known as the geological ages. This series of geological time-units, all determined in the last analysis by fossil evidence solely, is what is being considered in the following pages.

I have no disposition to deny that many phenomena in geology appear to have required much time for their accomplishment. Any one who so desires may assign ten times the accepted conservative average for the recession of Niagara Falls, for the digging of the Cañyon of the Colorado, for the making of the Mississippi delta, or for the accomplishment of any other single phenomenon among the rocks. Such estimates are well known to be always more or less matters of personal opinion, and so cannot do very much harm. My quarrel here is entirely with the solemn dogmatism which keeps on affirming, without the slightest objective or logical proof, that certain kinds of animals and plants lived long periods of time before certain others, the latter long before certain others, and so on for many successive periods covering untold millions of years. This affirmation does untold harm, because it is not regarded by the public as any mere matter of personal opinion or hypothesis, but is supposed to be a strictly scientific deduction from objective facts. The object of the following pages is to tear away the mask of scientific respectability from this notion, and to show that the pretended knowledge of distinctions in age among the fossils must be looked upon as only a hoax, a practical joke on a confiding public.

Natural science has in our day accomplished so many wonders that the public are inclined to accept without discrimination any asserted facts which claim to be scientific. Even the accomplishments of field geology (which have nothing under the sun to do with the theories we are here discussing) are being quoted to throw a false air of reliability over methods of reasoning about prehistoric times which are no more logical or scientific than the methods of astrology or theosophy.

Were the consequences not so serious in other respects, it would be a real intellectual amusement to watch the pompous solemnity with which certain literary men or clergymen keep on discussing the precise geological " age " of some deposit with which human remains may be more or less remotely connected, as they try to decide the momentous question of whether this deposit is " Pleistocene," or " Pliocene," or possibly " Miocene," according to the allegedly expert opinion of various geologists or palæontologists. This confiding faith of the public in the dicta of these " experts " would be a perennial means of banishing loathed melancholy, if on second thought it did not lead one to despair of ever getting the public to discriminate between charlatanry and real science.

I freely acknowledge that this classification of the rocks according to the fossils they contain has proved very useful. It is still a convenient working tool, for it furnishes an elaborate set of pigeon-holes into which any newly discovered set of beds from any part of the world may be instantly placed. In my own textbook[1] I have still retained this system of classifying the stratified rocks, though in that work the student is duly warned that such names as Cambrian, Devonian, Cretaceous, Tertiary, etc., have no real time-values whatever, but are merely convenient names for rocks containing certain kinds of fossils.

In the following pages I have given an outline of some of the reasons why strict scientific method is now compelled to say that these systems of rocks cannot possibly represent any real time-values to one who knows all the facts and who exercises an " unusually obstinate effort to think clearly," as William James has expressed it. However, as the present volume is only a brief popular work, I must refer the critical reader to my more formal discussion of this subject, where the argument is given in more detail.[1]

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[1] *The New Geology, A Textbook for Colleges* (1923); 726 pages, 452 illustrations.

It is no answer to my criticism of the grotesque logic offered for the geological ages to say that my hypothesis of a great world-catastrophe as the cause of much (if not most) of the fossiliferous deposits is incredible and absurd. Perhaps it is. But two wrongs cannot make one right. For even if such a world-catastrophe is considered quite outside the limits of serious discussion among men of science, such a charge can be nothing but a dodge or a subterfuge to divert the attention of the public from the perfectly devastating criticism which can now be directed against the theory of different age-values among the fossils. My attempt to explain how the fossils got buried may be a poor affair, it may be wholly incredible; but what under the sun has this to do in the way of rehabilitating the claims of geologists to be able to tell the age of a rock deposit by means of the fossils it contains?

Many others before me have charged that geologists have been reasoning in a circle in all their claims of establishing their successive " ages " by the evidence of the fossils. Spencer's essay on *Illogical Geology* and Huxley's accusation that the chronological scheme of the successive floras and faunas was " not proven and not provable," have not been alone in pointing out the bad logic of the larger geological theories. One of the latest as well as one of the most authoritative criticisms comes from Dr. Johannes Walther, of Halle University, Germany, who says that " we have indeed been reasoning in a circle when we attempted to correlate the strata of the earth by means of their contained fossils, and then inferred the time-value of these particular species of fossils from their occurrence in rocks of the same age." But the widespread phenomena of " deceptive conformities " and " thrust faults," as they are called, render the theory of successive types of plants and animals wholly false and absurd,—and it should always be kept in mind that this idea was never anything more than a theory for the world as a whole, invented to explain some local occurrences in England and Western Europe a hundred years ago, when geological speculators made no attempt to follow logic or strict scientific method.

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[1] *Evolutionary Geology and the New Catastrophism* (1926); fourth edition; 352 pages.

Besides the series of facts in criticism of the time-distinctions among the fossils, I have in the following pages pointed out the wrong method hitherto employed in attempting to work from the bottom of the fossiliferous rocks upward to the surface deposits, or from the earliest to the latest. I have attempted to show that the only safe or scientific method would be to begin (in explanation) with the present world of living plants and animals and work backwards into the past. . It is a false and treacherous method which would start with some hypothetical point of time in the past, say the Cambrian " period," and then by cosmic dead-reckoning try to work from that up toward the present; for this is beginning with the unknown or the unfamiliar and trying to bring this into relationship with the better known or the more familiar. The reverse is the correct scientific method, and if followed is far more likely to give us permanent results in our study of the rocky records.

Many important results seem to me to follow logically from the facts as we now know them; some of the more important of these results are given in the final chapter. I am not so optimistic as to think that all of my readers will agree with my attempt at a constructive programme; but I think I have a right to expect that all who will carefully consider the evidence must agree with me that there is no scientific evidence to support the commonly accepted notion that geologists have the magical skill to differentiate among the fossils and set them off into successive ages. The time-values of the fossils must be forever discredited in the minds of those who value facts alone as the solid ground on which any science can be built that is to endure.

G. McC. P.

*Berrien Springs,*
*Michigan.*

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# I

# THE PROBLEM OF GEOLOGY

SUPPOSE there were a great globe away off somewhere in space, and you were asked to examine it in detail and make a scientific report upon its physical history. And suppose you found this globe to be somewhat like our earth, covered quite generally with rocks in strata or layers, evidently formed by moving water at some time in the past, these rocks containing many relics of plants and animals which must at some time have been alive and got buried in the places where we find them while the rock materials were soft. Your problem would be to examine this entire globe in a full and scientific manner and to make your report upon what had happened upon it in the long ago, in the light of the best evidence you could decipher from these rocks.

Evidently your problem would be very much like that of our modern geologists. You would be a sort of coroner, a cosmic coroner, holding an inquest over this globe, and especially over the many dead things contained in the rocks, in an honest endeavour to reach real truth so far as would be within your power.

What method of investigation would you adopt? Obviously you would want to know first of all the present behaviour of the various forces of nature now operating over the face of this globe, how the water, the air, and the weather are now operating over its surface in any way; then by projecting this present-day behaviour back into the past you would try to judge whether or not these present-acting forces of nature would be sufficient to account for the effects found recorded in these rocks. Above all, you would need to obtain a full and accurate knowledge of the living plants and animals, where they occur, how they behave and reproduce, how they become modified under changed environment; for the relics of ancient life found in the rocks, called fossils, must always constitute our chief source of information regarding the changes over the face of the globe which we are examining. It is self-evident that we would not be prepared to frame any safe or reliable theory as to the causes of the ancient changes, until we had learned all we possibly could regarding the modern forces of nature and also concerning the distribution and behaviour of the animals and plants now living.

But, consciously or unconsciously, you would almost certainly make some sort of theory as to the manner in which these fossils got into the rocks; and you would also frame some such theory just about as soon as you first saw them. It would be quite contrary to human nature to hold your mind in a strictly non-committal attitude until all the evidence was available. The information called for by the latter procedure would take a very long time; it could not be completed in one lifetime by any one person; it would require the co-operation of many persons in all parts of the world, perhaps for many successive generations. But this method of gathering in all the evidence before drawing any conclusion would be the only scientific procedure. It would be extremely unscientific to jump to a conclusion regarding a matter of such vast importance, while as yet we had only a small portion of the data necessary for framing a safe induction regarding the physical history of the globe we are supposed to be examining.

Let us come back to our own globe and the actual problems connected with its past. And let us ask, Have geologists followed the methods outlined above? To ask this question is to answer it, so far as those acquainted with the history of science are concerned.

Until about a hundred years ago geologists were essentially collectors of curiosities, giving no more attention to scientific method than is now associated with the collecting of old coins or postage stamps. But they were also wild dreamers and speculators; for the relics of ancient plants and animals were used by them as mental spring-boards from which to launch away on the wings of airy fancy about how the world was made and what innumerable vicissitudes it had experienced in remote ages. They felt under no obligation to hold their theories within leash until a reasonable amount of facts about the entire world had been gathered together; they scorned such dilettante and dilatory methods. The man who had found one or two strange-looking fossils in some locality in England or France or Germany immediately proclaimed a complete theory concerning the past, the present, and even the future of our planet;—though it must be confessed that some of our modern men are not far behind in such work, when a fragment of an ape's skull from South Africa or of a " million-dollar " pig's tooth from Nebraska are sufficient excuse to set the telegraph wires humming or the presses turning out a lifelike picture of what happened ten or a hundred million years ago.

We must remember that all the early geologists were untravelled men. A. G. Werner and "Strata" Smith had never wandered much beyond the horizon of their own dooryards. Charles Lyell was the first student of the rocks to make a business of actually visiting and examining the rocks of Western Europe and Eastern America; but what could one man do in such a herculean task? Darwin and Wallace and a few others supplemented Lyell's work with a few observations and a few specimens collected from the Southern Hemisphere. But it was quite a little over forty years after Lyell's first book on geology before he or the rest of the world knew anything worth calling science about the conditions now prevailing at the bottom of the ocean; and the facts from the deep oceans certainly are the key-facts in interpreting the fossiliferous rocks.

The world is still being browbeaten by the theories and methods of the youthful Lyell, scarcely out of his teens; but one of Lyell's worst obsessions was concerning what he was pleased to term "extinct" species, although subsequent discoveries in various parts of the world, especially from the depths of the ocean, have shown us almost innumerable living examples of creatures which he thought to be extinct and on the basis of which he formulated some of his most important theories about the entire globe because he said they were extinct. Accordingly, when we remember that the surface rocks of the entire globe (which must be the most important of all the rocks, because connecting the present with the past) are still tabulated off *a la* Lyell into successive ages on the basis of the percentage of living and "extinct" shell-fish which they contain, what confidence can we longer retain in the scientific accuracy of this tabulation?

In order for our theories regarding the past of our world to be reasonably safe and enduring, these theories must be based upon a sound knowledge of the rocks of the world as a whole, they must include a comparison of the rocks from a reasonable number of localities all over the globe. They must include a reasonably complete knowledge of the invertebrates from the deep seas, as well as a knowledge of the plants and animals in most of the out-of-the-way corners of the world. They must be based also on a knowledge of the present behaviour of the crust of the earth, especially of the shore-lines around all the lands, in order to be able to decide with certainty whether the lands and the ocean are at present undergoing any regular and measurable tendency toward a change of relative level.

Geology must build on all the other sciences. Only as chemistry and physics have become settled and reliable can we trust to our views regarding the inorganic parts of the earth. Only as our knowledge of all the living plants and animals becomes reasonably complete can we form opinions regarding their relationships to the fossils which we have a right to call scientific. Only after the depths of the oceans have been explored, and after the coast-lines around all the continents have been accurately surveyed and studied, can we have reliable data with which to frame any intelligent opinion as to whether the oceans and the lands are at present showing any tendency toward changes of level on a large scale.

But such detailed and accurate information is only now beginning to be available. When Charles Lyell, about a hundred years ago, at the mature age of twenty, set out to reform the science of geology by comparing the present with the past and making the present the measure of all the past, he knew nothing worth calling science about any of the points enumerated above. Even at the close of his long and active life, diligently busy as he had ever been with accumulating facts regarding the present and the past, he had gathered only a smattering of knowledge of these various subjects. For a hundred years the rocks in all parts of the world have been interrogated in the language which Lyell taught earth-science to employ. And if at the present day facts have been accumulated on all these important subjects which qualify us at long last to formulate some reasonably certain conclusions regarding the changes which have taken place in the earth's surface, an intellectual revolt against Lyell's theory has been deferred hitherto only because of the modern tendency to undue specialization, by which it now comes about that even the subdivisions of geological study are divided off into watertight compartments, so that the workers in one compartment are often quite unaware of what is being accomplished in other divisions of even the same science.

The method adopted by Lyell of making the present the measure of the past was right so far as it went as an approach to the study of the subject. It has given us the facts necessary to begin intelligent comparisons between the past and the present. But Lyell erred in not carrying this method far enough. He should have included the animals and the plants now existing in all the various parts of the world, and should have made them the basis of exhaustive comparisons with their relatives found as fossils in the rocks. Instead of dwelling on the *differences* between the fossils and the modern kinds, Lyell should have emphasized the many and striking *similarities*, as he was so fond of doing in regard to the streams and the volcanoes. Also instead of beginning away back at some hypothetical beginning of life and working up toward the present by slow stages and a sort of cosmical dead-reckoning, as he had found the previous students of the rocks already doing, he should have started with *the present order of things among organisms*, the modern living forms of plants and animals; and should then have sought to work carefully and scientifically backwards into the past, to discover if possible how the present order of living things is connected with that dead world whose ruins lie buried beneath our feet on every continent. This would have been consistent with his methods in the inorganic world. In fact, it is the only safe and reliable method, the only method truly scientific. Consistently and thoroughly applied, after an accurate gathering of a reasonable amount of data, this method of working from the present order of things backward into the past would be bound to give us firm and dependable results.

Undoubtedly this is the method of tomorrow in geology. It is the only consistent and scientific approach to the study of the past of our world. The bare rocks themselves, consisting of gravel, sand, and clay, any of which may be consolidated or not, can tell us but little about the world as a whole. They tell us of mere local conditions; they give us little or no information about such matters as changes of climate or of changes in life, in the floras and faunas. The fossils alone give us the key to the past. But it is the supreme folly of all pseudo-science to begin somewhere away back at the vanishing point of the vistas of a past eternity and to attempt by sheer cosmic dead-reckoning to work up to the present by slow stages, and to arrive here with a sufficiently small cargo of "living" species unaccounted for, so as to splice on smoothly and easily with the present on the basis of uniformity among the rocks and transformism among the plants and animals. This is the supreme type of all hypothetical science, a magnificent hang-over from the scholasticism of the Middle Ages; it has no resemblance to the secure sciences of objective facts, after the order of Galileo and Newton, of Bacon, Linnæus, and Pasteur.

The method of regression from the present into the past undoubtedly has its limitations. It will not permit us to indulge the pleasing fancy of thinking that we have methods for a scientific cosmogony, or that we can discover how the world was made. But these limitations are the limitations inherent in all objective science. The latter can proceed only so far as the facts permit; when she runs out of pertinent facts true science must call a halt and say, "Thus far and no further." But it has one very great advantage: it can be sure of its results, so far as it is able to go. And this is surely a wonderful advantage over the speculative method, which can never be sure of anything,—except that it will always be blundering.

It is because the false methods of fantastic speculation have hitherto prevailed in geology and historical anthropology, that these sciences have so often been compelled to revise their "assured results," contradicting today what they declared yesterday. And it is because of this long trail of blunders that these sciences have become the byword and the subject of scoffing among those who have learned to trust in the settled results of those sciences which have transformed our living conditions within one generation. Chemistry and mechanical physics are examples of the true scientific method *par excellence;* geology and archæology will become secure sciences worthy of confidence only as they approach the methods of the former. Their present methods, which have been the cause of all the confusion about transformism and the pseudo-scientific speculations about the animal origin of man, have brought unnecessary reproach upon the fair name of natural science. This reproach will be wiped out when, and only when, geology adopts the reformed methods of starting from the present and working back by regression into the past of our earth's history, and stopping when it comes to the end of its very definite and very well known limitations.

By this new method in geology I mean that we should start with all that we know or are able to learn about the living species of plants and animals, including man. We must know their present geographical distribution, their possibilities of variation under great changes of environment. Then, with all inherited prejudices about " extinct " species discarded, we should go backward among the strata and find where and under what conditions the fossils of these living forms occur, and then decide how these fossils were buried and how the intervening changes in land-and-water distribution must have taken place. This means that we must begin at the surface of the earth and work downward, instead of beginning at a supposed bottom of the fossiliferous strata and working upward. As will appear later in this volume, we can't be sure of any real bottom of the fossil-bearing rocks, since any and all of them rest directly upon the granite.

World-changes in climate and atmospheric conditions will need to be considered. The problem of how and when the mountains were made will have to be solved; for it is one of the outstanding astonishments of geology that all over the globe the mountain making seems to have been about the last thing on the geological programme, and seems to have been accomplished simultaneously the world over.

Under the new method of working from the present into the past it will make no difference to us whether the fossils of our modern forms are found in rocks called "Palæozoic" or "Mesozoic;" these long-popular distinctions in age among the fossils are some of the worst results of those false methods which we must try as best we can to outgrow and forget. Of course we shall have to make distinctions in age between the various deposits; but to be of permanent scientific value these distinctions will have to be arrived at by methods far different from those taught us by "Strata" Smith and Werner and Cuvier. But as our first approach to the problem under the reformed methods we shall be concerned only with noting where and under what conditions the fossils of our modern living species are found occurring. By such a study we may be able to reconstruct the floras and faunas of the world immediately preceding our own, and may attempt to find out how that marvellous world was changed over into our modern one. Then whatever fossils or fossiliferous rocks we have left over still unaccounted for under our new methods, we may assign to the indefinite and indeterminate period of the earth's previous history. But we may also be confident that whatever results we arrive at under these methods will be permanent and not subject to revision every few months.

The two methods in psychology are quite similar to the two in geology. Under the old system of psychology the student tried to start with the simplest sensations first experienced by the infant, and then attempted to combine these (hypothetical) infantile experiences into the processes of thinking of mature life. It was a hypothetical method, and if by good luck it happened to arrive at some permanent scientific results, these results were not due to the methods employed. The new or scientific psychology no longer attempts to start from any assumed simple infantile experiences; it contents itself with working from the present backwards into the past, as best it can, well aware of the limitations of such a method; but also aware that this is the only real scientific method of procedure.

The two methods in archæology illustrate similar differences. The one method is usually known as historical anthropology or prehistory, the other is what may be termed archæology proper.

Historical anthropology is merely an appendix to the evolutionary scheme of geology. All the false methods and inconsequent conclusions of Lyell's geology become the starting points for this sort of historical anthropology in its version of the early days of mankind. It attempts to make a good splice with the last end of geology; but in so doing it is in effect starting at some hypothetical point of time in the past, from which (hypothetical) point it then tries to work up towards the present. In other words, it begins with what is less known or much more imperfectly known, and by methods borrowed from evolutionary geology it then attempts to work up toward the more known, or the much better known, namely, the present.

On the other hand, historical archæology, or archæology proper, begins with the known facts of history or the present period of human existence, and attempts to work backward into the past. In doing so it is proceeding according to safe and reliable principles, and is correctly scientific in its methods. Its rival, historical anthropology, is unsound and unscientific in every fundamental method which it employs.

The amusing travesties of man paraded in our museums, thus imposing on the public which trust with childlike confidence in everything which claims to be "scientific," have made the results of this kind of anthropology familiar to all. Under this method the alleged history of mankind is made to stretch back many hundreds of thousands of years, some say for a million or two; while between these awesome beginnings and the known period of real human history stretches a vast hiatus with nothing to show for it in the way of real human remains. On the other hand, the careful students of archæology, working back from the earliest remains of mankind recoverable from Egypt and Babylonia, find that they cannot extend the authentic period of early man further backward than a very few thousand years, thus agreeing quite well with those earliest records of mankind which have come down to us through the Hebrew Old Testament.

The old method of psychology and the still-prevailing method of anthropology are closely analogous to the methods of evolutionary geology so long taught to the world in the names of Lyell and Darwin. All three sciences are attempting to deal with problems which resemble historical investigations (the old psychology being individual history on a minute scale); but all are handicapped by difficulties inherent in the very nature of the subjects which are being investigated. But because of these inherent difficulties it is all the more imperative that in all of them we follow only sound inductive methods; otherwise our conclusions can have no permanent value.

If geology can once be reformed in its methods, it will then deserve to rank with these other two reformed sciences, and can then be welcomed into that illustrious company of investigative studies which are concerned with facts only and the secure deductions which may be derived therefrom. And the results of such studies can then be depended upon for true views about the past of our world.

## II

## SOME PROOFS OF RECENT LAND SUBMERGENCE

AS one comes eastward through Wyoming, in the region of the Lincoln Highway or the Union Pacific Railway, one crosses what is termed the continental divide at Creston, some 146 miles west of Laramie. This point has an elevation of 7,107 feet above sea level; though in reality this is not the highest point on the railroad, the latter being at Sherman, which is rated 8,013 feet in elevation and is about half-way between Laramie and Cheyenne. Old bosses of red rocks project through the surface at many places, while to the south of Cheyenne a vast rolling prairie stretches away to the south and east, sloping gradually to the Missouri and the Mississippi.

Throughout all this region, particularly to the south of Cheyenne, one cannot fail to be impressed with the visible evidences almost everywhere of a vast mass of water as it stood here for a short time, forming real sea-beaches still so clearly marked, or was gradually drained from off these lands. And this vast mass of water must have been here at no very remote period; otherwise the many visible signs of the retreat of the water would long ago have been obliterated. These marks are as fresh looking as if the water had been here only a few centuries ago. The marks of the Romans over much of the island of Great Britain are less distinct than the handwriting of the ocean in its retreat from off the great-plains region at the foot of the Rockies.

The evidence is various and cumulative in character. For example, as we face southward and travel from Cheyenne, say twenty or thirty miles toward Denver, we notice some low-lying mesas on the west, with still lower ones on the east. These mesas were once left as islands during the last of the retreating waters. At one point it is only about a mile between these erosion remnants, the intervening plain being almost horizontal. Following further to the south, in the line of this old drainage channel, one notices a mass of rocks in the middle of the channel, wide and deep depressions being still visible on either side of these rocks where the increased rapidity of the waters swirled around them. About a mile still further south we come upon the upper end of a modern ravine, made by the head of a modern little stream as it cuts backwards into the soft alluvium.

This particular assemblage of phenomena might be duplicated a hundred times all up and down the front of the Rockies from the Gulf to the Arctic. Thousands of picturesque mesas occur throughout this region, all of which were once surrounded by a retreating ocean; for to bring up water around them in sufficient volume to do the work so plainly marked on their sides, would require the entire Mississippi Valley to be full of water. In many instances, also, it seems evident that it was the same mass of water that first deposited the beds composing these mesas, and then finally by its hasty retreat washed away their sides, leaving them as erosion remnants still eloquent regarding their origin. For the region we have been speaking of is as it were the very roof of the continent; and yet we find here the unmistakable handwriting of a vast retreating ocean,—or of an emerging land, which would be the same thing.

No cause within human knowledge is capable of doing the kind of work here recorded except a mass of moving water in sufficient volume to surround these island-mesas and fill these enormous channels which stand wide open to the broad valley of the Missouri and the Mississippi. Similar phenomena on a smaller scale occur among the mountains in the eastern part of the continent, and indeed in similar situations all over the world.

But why should such phenomena be most conspicuous in such a region as the one described in Wyoming, near a great continental divide, or at the very peak of a continent? At lower levels and in regions of much greater rainfall these marks are often obliterated by subsequent erosion; yet at these lower levels we often find other features which tell substantially the same story.

Along the courses of very many rivers throughout America, from three to four or five hundred feet above their present beds, are river-terraces which mark the height at which these rivers once flowed. Usually these marks indicate currents hundreds or thousands of times the volume of the present streams. Somewhat similar-looking water-marks are to be seen around most inland lakes often a thousand feet or so above the present level of the water. These ancient terraces or benches and the ancient shore-lines are found to be composed of gravel, sand, clay, and loam, sorted and deposited by water, the detritus from regions still higher or from land-masses which perhaps have vanished entirely.

If we go to Europe or Northern Africa or to the lands to the east of the Mediterranean, we again find the same tell-tale marks of a retreating ocean. There are old beaches or strand-lines at the higher levels; while at the lower levels we see the high river-terraces some three or four hundred feet above the present sea level, with various other terraces at successively lower levels, until the beds of the present rivers are reached. The Rhine, the Danube, the Garonne, the Moselle, the Somme, and the Loire show terraces at about the same heights; while by following these terraces down the rivers to the coasts it has been found that old shore-lines occur at corresponding levels not only around the greater part of the Mediterranean, but also on the Atlantic side. Similar high river-terraces have also been noted at similar levels along the Euphrates and the Nile, the highest terrace on the latter river and its branches having been formed while the water was flowing at the level of the present desert plateau. Similar conditions are known to exist along the courses of all the great streams of the world; but exact measurements have not yet been made to correlate them together.

As I shall have occasion to show in a subsequent chapter, there were probably larger glaciers than at present immediately after what I have called the great world-catastrophe, these larger glaciers having been due to the immensely larger lakes and inland seas then scattered over all the continents, and to the fact that the warm waters of the antediluvian oceans would take many long years to cool off to their present icy temperatures, so that in the meantime this warm water would always float on top, causing continual cloudiness and excessive humidity in all the regions of the globe.

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Since the mountains at that time were probably covered with soft, freshly-laid strata, the heavy accumulations of snow and ice would in a few years or centuries result in vast avalanches down the sides of these mountains, these avalanches producing what are commonly termed " moraines," and leaving the bare rocks—

> *". . . of the iced mountain's top,*
> *Where the birds dare not build, nor insect's wing*
> *Flit o'er the herbless granite."*

Thus between the vast dump-heaps made by these primitive avalanches, and the old sea-beaches left by the retreating oceans, we can readily account for all those masses of irregularly stratified materials which occur around the bases and the flanks of all the great mountain ranges. At somewhat lower levels we find the high river-terraces, which in so many instances (as we follow them up to the sources of the streams) are seen to interdigitate with the so-called moraines, or what I call the old shore-lines and dumps of the avalanches.

These phenomena, which occur literally in all the lands of the world where there are high mountains, are eloquent testimony of the time when the lands were emerging from beneath the waters, or when the oceans were retreating away to their present reservoirs, where they still obey their orders, " Thus far and no further."

Closely connected with the phenomena we have been considering is the problem of the making of the great mountain chains of the world. Naturally enough the evolutionary geologists would like to have the mountain making of the world take place a little at a time all down the "ages." But the mountains do not prove very accommodating; for they all contain strata with such "young" fossils that essentially the entire mountain making of the world seems to have taken place only after all the stratified deposits had been formed. Bailey Willis, after a careful study of the great mountain systems of Asia, declared that these great ranges "challenge credulity by reason of their extreme youth," and adds that their uplifting "appears to fall chiefly within the Quarternary," though some of it may be placed at the close of the Tertiary. So far as I know, all other geologists are agreed with him in this. Similarly the Alps, the Andes, the Rockies, indeed all the other great mountain systems of the globe contain evidence which proves that they were uplifted only after the entire geological series of stratified deposits had been laid down.

Dana, who belonged to the old school of geologists and did not shrink from invoking great terrestrial convulsions when necessary, tells us that it has been thought incredible that the climax of the mountain making "should have come so near the end of geological time;" but he adds that "the fact is beyond question."

Now I have no interest whatever in any one's objection that this making of the mountains must have been a long, long time ago. He can make it as long as he likes; the fact remains that the uplifting of the great mountain ranges of all the continents seems to have taken place only after all the other geological work had been completed. The mountain making is about the last item on the geological programme. And it seems to have taken place all over the world at substantially the same time.

Such a great outstanding fact fits so remarkably into the set of other facts which we have been considering that it will never do to ignore it when we are trying to frame a true induction from all the geological phenomena. In fact, if we are to make a heuristic study of the geological problem, and if we begin with the present and work backward into the past, this great problem of the uprearing of the mountains of all the continents will be the first thing to confront us, for it stands squarely between us and that fossil world whose relics help to compose the strata of which these very mountains themselves are made.

We are thus squarely confronted with the problem of *how* the various geological changes took place. Lyell and his followers have always said that the land is constantly rising in some places and sinking in others; that in this way the bottoms of the seas have been lifted up to make the lands, and dry lands have been depressed in other places to make new sea bottoms. Thus they would seek to account for that wonderful alternation of land plants and deep-sea fossils, which is one of the outstanding facts of the stratified rocks. In Lyell's day this see-sawing of the lands, or the pulsating of the crust, as Dawson called it, was supposed to be actually going on at the present time. But a more careful study of the actual facts about the land surfaces in relation to the sea have shown that this is not so.

Edward Suess, of Vienna, one of the most judicial of modern geologists, made a careful study of all the reported measurements around the coasts of Scandinavia and in other parts of Europe, and he came to the conclusion that in none of these places do we have any physical proofs that such changes of land and sea level are now going on; as he expresses it, " displacements susceptible of measurement have not occurred within the historic period." And he adds that since no such land-movements are now going on, we cannot appeal to present-acting causes " in explanation of the repeated inundation and emergence of the continents."

Those most competent to judge of such matters in this country are equally positive. Douglas Johnson, of Columbia University, who is the chairman of the Committee on Shoreline Investigation appointed by the National Research Council, after years of study of the facts, tells us that "At present all arguments for changes in the relative level of land and sea based on observed changes of mean sea level are open to suspicion."

Thus it is evident that we cannot point to any modern processes which will serve to explain those great changes which we find recorded so unambiguously in the rocks of all the world. The causes which produced these world-changes are not now in operation. The chief assumption of Lyellism is thus proved to have been a blunder.

Evidently the world-events immediately preceding our present arrangement of ocean and dry land must have been of a very exceptional character, quite distinct from the conditions now prevailing. In other words, it now becomes certain that the geological events of the period immediately preceding the present were of an extraordinary character, and that these strange conditions were of world-wide significance and extent.

And yet the evidence of the old shore-lines and high river-terraces scattered over all the continents proves that these strange conditions prevailed at no great length of time in the past. For the physical records are still so clearly legible, and the modern species of plants and animals are so inextricably involved in these earth-changes, that we cannot assign to these events any great antiquity. Of course, it is quite hopeless to try to read *time* from any of these phenomena of nature,—I mean absolute time. Relative time in many cases we can recognize; but no attempt hitherto made to read absolute time from the rocky record has proved of any scientific value. All we can say is that these great earth-changes, the formation of the high river-terraces, the making of the old strand-lines, the retreat of the oceans from off the lands, and the uplifting of all the great mountain ranges, must have occurred since the present kinds of animals and plants (doubtless also mankind) were living throughout the world, though very differently distributed from the way in which we find them at present.

All of the facts which we have been considering show that at some time in the past a tremendous change of some kind must have taken place over the surface of our earth. What this change was like, and what caused it, we are trying to find out. These problems constitute the subject of this book. But just now our next task will be to study some of the kinds of life which we find buried in the rocky strata; for they lived and were buried *before* the surface changes which we have just been considering.

We are thus proceeding from the present order of things backwards into the past, which I have said is the only safe method. Whether we can at present make a good splice between that ancient world (the antediluvian) and the modern, may be somewhat doubtful. For this is a pioneer attempt, and all pioneer work is always crude and imperfect, subject to repeated revision. But we are making the attempt. And so in the next chapter we must consider some of the leading characteristics of the great fossil world which lies buried beneath the surfaces of all the continents.

## III

## LESSONS FROM SOME PREHISTORIC MONSTERS

THE great problem of geology is, How were the stratified rocks formed? We have seen that the only scientific method of attacking this problem is to study the world as a whole, after having gathered all the facts within reach about the present forces of nature and about the modern animals and plants. The traditional method in geology is to begin away back at some imaginary point in the dawn of a past eternity, and then endeavour to work up to the present by slow stages, marking off our fancied progress in "ages" and assigning certain characteristic forms of life to each of these great periods in the world's history. The correct scientific method would be to begin with the present world, with all that we know about our modern earth and its living inhabitants and the forces now operating over the earth's surface; then by working backwards into the past, or by working from the surface phenomena downward into the strata, we may hope to find out what has happened to our world in the long ago, and how the fossils got buried in the rocks where we now find them.

The present is a mere outline of this method of study. But we have already seen that over the surface of all the lands we have tell-tale marks of very recent land-submergence. Immediately back of this, and doubtless intimately connected with the retreat of the oceans from off the continents, would be the uplifting of the great mountains of the world, which we have shown upon the highest testimony to have been a very recent event, and *essentially one event throughout the world,*—at least we have not hitherto discovered any safe method of assigning some of these mountains to one period and some to another.

The terraces and old strand-lines around the bases of the great mountains also seem to be fairly equivalent in time throughout the world. At least there are no outstanding differences to be noted between them. And all of these phenomena give unmistakable evidence that these great earth-changes could not have been so very long ago; for many thousands of living kinds of plants and animals are found embedded in the strata of the mountains and in the deposits left by the retreating waters.

We are still trying to hold our minds in restraint as to how this all occurred. We can hardly claim that Lyell's uniformity theory is still *sub judice;* but at any rate we have not yet committed ourselves to the one-big-catastrophe theory, or to the theory of many successive catastrophes. As yet we do not have all the evidence; and we must not decide these matters hastily, for unreasonable haste in generalizing has ever been the bane of geological study.

I must assume that my readers are already familiar with the leading facts of zoölogy and botany. These facts are essential as a preparation for the study of the fossil world; and our next investigation must be to get a broad view of that world of dead organisms which we find entombed in the rocks.

Where and how shall we begin? Shall we start with the smaller forms of life, the creatures found almost exclusively in the deep oceans, such as the foraminifera and other protozoa, the sponges, the echinoderms, etc., and proceed from them up through the fishes, reptiles, and amphibians to the mammals? Or shall we reverse this method, beginning with the higher vertebrates, such as the huge mammals, working back or down to the reptiles and invertebrates? The former is the usual method; and experience shows that this method seems to give a false reality to the development hypothesis. So let us continue the method with which we have set out, and begin with the huge mammals which once roamed around over the continents but which have since disappeared either locally, from North America and Europe, or have entirely disappeared from the earth.

The broad fact is that at some former time (never mind how long ago, or whether longer ago than other geological facts or less long ago) such animals as elephants, various kinds of rhinoceroses and hippopotamuses, with many other semi-tropical animals, used to live in great abundance in North America and Western Europe. Many plants and trees now confined to America formerly grew in Europe, presumably contemporary with these animals, such as the magnolia, the maple, the tulip tree, the sassafras, the hickory, etc. Such trees also grew in the extreme latitudes of the polar regions, together with sequoias, breadfruit, grape vines, and even palms and ginkgos.

Great numbers of animals and plants now confined to tropical or semi-tropical regions flourished throughout all the northern lands; *and the shifting of entire floras and faunas to the other side of the world is almost as great a problem as if they had become entirely extinct.* But monstrous mammals have disappeared from these northern latitudes also, the moropus, the glyptodon, the megatherium, the titanotherium, and many, many others, their very names sounding as outlandish as their skeletons appear bizarre, for we know them only from their skeletons which stare at us in most of the big museums.

And there is unquestionable evidence that the change of climate indicated by many of these facts must have occurred with astonishing suddenness. For great numbers of the elephants and other animals were caught and frozen in Northern Siberia and the extreme Arctic islands, their flesh having been kept constantly in this frozen condition ever since, for in many instances it is still in a condition fit to be eaten. This change of climate, which must have been sudden and as permanent as it was sudden, is one of the great outstanding facts which will have to be taken into consideration, whenever we try to frame a safe and sure induction as to how the stratified rocks were formed. It is not science but a subterfuge that pretends that vast herds of elephants could live in the present climate of Siberia and the islands of the extreme Arctic, from which elephant tusks have been shipped by the ton for more than two hundred years.

Another group of animals which we must consider is the large reptiles. They are chiefly comprised under the now-familiar name of dinosaurs. There were little dinosaurs as well as big; dinosaurs of the air, or flying dinosaurs, some of them with a spread of wing of more than twenty feet; dinosaurs of the sea, some of them a hundred feet long; and many various dinosaurs of the lands, the most spectacular being huge monsters sixty or seventy feet long, some of which weighed as much as ten elephants.

These big beasts formerly lived on all the continents, North America, Europe, Asia, East Africa, South America, Australia. What was it that killed them all off? No wonder Charles Schuchert says that "the dramatic extinction of this mighty race" is "one of the most inexplicable of events;" for we know that reptiles are notoriously tough and hard to kill, and are peculiarly unaffected by parasites or disease. How did they all happen to die off? Henry Fairfield Osborn adds to the difficulty by telling us that "the cutting off of this giant dinosaur dynasty was nearly if not quite simultaneous the world over." Certainly the case begins to look pretty hard for Lyell's uniformitarianism.

We are not now saying that this extinction of the dinosaurs occurred at the same time as the shifting of the semi-tropical elephants and other animals, with the palms and breadfruit and associated plants, from the arctic regions to the present tropics. That also is a matter for study and subsequent decision. We are out to get all the facts first. The evolutionary geologists claim that the dinosaurs lived long before the mammals. We shall see.

We might take the other forms of life almost at random; but it may be well to consider the fishes. It is a very noteworthy fact that in all parts of the earth we find shales and limestones and other rocks packed full of fishes, buried in such unbelievable quantities that the mind is staggered in attempting to compute the numbers involved. In most instances of this sort, the fishes are remarkably well preserved. The fins and scales are in position, the entire outline of the soft parts is shown, thus giving proof that the creatures were buried before any perceptible decomposition had taken place; and we all know that dead fishes are about the most putrescible of substances. In many cases the form of the animal is twisted or contorted, the fins stick out, as if the creature had been buried alive or had died in convulsions and had been instantly buried. Hugh Miller gives this as the usual condition among the fishes of the so-called Old Red Sandstone of Scotland; and the great abundance of fishes in these rocks gave origin to the theory of an "Age of Fishes." Subsequent discoveries, however, have shown that all the other formations are about equally liable to contain great numbers of fish remains; so the latter term has been gradually dropped.

In 1923 there was published by The Macmillan Company, New York, a book entitled: *Fishes the Source of Petroleum.* The author is Professor John Muirhead Macfarlane, of the University of Pennsylvania. It is a learned and carefully documented work; and the author makes out a strong case for his thesis that fishes, buried in prodigious numbers, have supplied much if not most of the materials for making the oil deposits of the world, including the materials which saturate so many shales. For while petroleum was at first thought to be confined to certain formations of the Palæozoic, it is now known to occur in all the other formations down to the Tertiary.

Thus two facts stand out in clear relief: first, that all the geological formations contain huge quantities of fishes, and all the known kinds of fishes are found buried in prodigious numbers; second, that all these masses of fishes must have been killed and buried in some catastrophic manner. Dr. Macfarlane admits the extraordinary or catastrophic character of these fish deposits, though he has accepted without criticism the common theory which would make these catastrophes into a long series covering many millions of years. But if we find in some of the next chapters that there is no good scientific reasons for thus stringing out these catastrophes in a series over a great length of time, because all these different kinds of fishes may have lived contemporary with one another, then the catastrophic character of their destruction will become all the more apparent.

Of course, great numbers of fishes are occasionally being killed today. Poisonous gases or earthquakes or various other agencies have been known to kill the fish over many square miles of area. But a very essential point to note in this connection is that such victims are *not buried suddenly* under any known modern conditions. It seems doubtful if a single instance has been known in modern times of a real fossil fish having been formed under any conditions at all similar to those so universally recorded in the rocks.

The facts here recorded of the fishes are almost duplicated in the case of the plants composing or associated with the coal beds. The vegetation associated with the coal is often most exquisitely preserved, indeed this is the usual thing in the shales above the seams. In the early days of geology we used to hear a great deal about the "Coal Age;" and at that time it was supposed that all the plants producing the coal were "extinct" kinds which lived only in strange conditions amid bogs or swamps. But now we know that splendid coals are found also in all the other formations "subsequent" to the Carboniferous, the coals of Alberta and British Columbia being Cretaceous, those of Germany and Australia being Tertiary, besides many others. This means that the kinds of trees which produced these coal beds in Alberta and Germany and Australia were not swamp-plants at all, but grew in well-drained uplands. But in many instances they have made just as good coals, certainly just as extensive coal beds, as the plants classed as Carboniferous. And if we look at the world as a whole, it is probably safe to say that trees and plants from well-drained uplands have probably produced more coal than the plants reputed to grow only in swamps or bogs. All of which throws a grave suspicion over the theories formerly used to explain the origin of the Carboniferous coals of England and Pennsylvania.

There are extensive peat bogs at the present time. But as was said of the modern fishes, these modern deposits of vegetable matter are rarely if ever *being buried.* Indeed it seems doubtful if enough vegetation has been buried in a century the world over, and since then transformed into good coal, to keep a cook-stove running a week.

No; the coal beds were not formed under anything like modern conditions of deposition. Everything connected with their formation points to a great convulsion of nature which swept masses of vegetable matter, much of it fresh and green, though part of it was the long accumulation of centuries, pell-mell into shallow basins of a subsiding land, where layer after layer of this vegetation was buried by something like huge tidal waves, the waters often bringing in corals or crinoids or other animal remains from the ocean, often from the very depths of the ocean, which were then buried in layer upon layer alternately with the plants. In one of the areas in Nova Scotia there are seventy-six of these successive layers of vegetation; in other countries eighty or one hundred, or even more.

Through all these successive beds, in any particular area, the kinds of plants remain the same, proving that no long millions of years with their inevitable changes were involved in growing these plants and trees, but indicating that the materials all came from one common source. Many other proofs of a sudden and catastrophic burial of the coal plants will be found given in the author's *New Geology*.

We might continue this phase of the subject to take in a study of the fossil brachiopods and mollusks, the crinoids and corals, and the many other kinds of invertebrates. Among all these classes there are many tell-tale proofs of very abnormal conditions connected with their burial, though we have not the space to enumerate them here.

From the facts given in this chapter we must conclude that either a long series of catastrophes, or one big world-extensive one, must be assigned as the cause of the burial of the fossils. The earlier geologists held to a theory of a long series of catastrophes; for at that time they thought they could differentiate among the fossils and assign some to one age and some to another.

Within modern times, however, many facts have come to light which tend to prove the *unity* of that ancient world and to show that the attempt to subdivide these buried forms of plant and animal life, assigning some to one age and some to another, is all a big mistake. Most of these facts will be considered in the following chapters. Here we must briefly mention two other facts which help to prove the unity of the ancient fossil world. These two facts deal with the subject of climate, and the marked degeneracy in size when we pass from the fossils to the modern forms.

As we have seen in the previous pages, the ancient world was characterized by a most wonderful climate, in which delightfully mild conditions prevailed over all the polar latitudes. This climate of spring-like loveliness apparently was continuous and uninterrupted until that fatal and sudden change (whatever its cause) which put the vast herds of elephants into cold storage, the evidence for which is familiar to every intelligent person.

Now it is a very instructive fact, though one not so familiarly known, that the fossils as a general rule are larger and more thrifty-looking than their modern representatives. One might run through the entire list, from the many kinds of invertebrates, up to the amphibians, the reptiles, and the giant mammals which used to roam around over what we now call America and Europe and Asia. And when we attempt to compare these ancient creatures with their modern representatives, the change in size and vigour is just *as marked and as sudden as in the matter of climate.*

Both these facts help to emphasize the unity or oneness of the fossil world, and help to show the sharp distinction between that ancient world and the modern one.

Several other very important facts derived from the methods of arrangement among the stratified rocks will be considered in the following chapters. They also help to show that the fossil world was a unit in many remarkable respects.

# IV

# WHICH ARE THE OLDEST FOSSILS?

WE must now take up specifically the question of whether or not distinct ages can be recognized among the fossils of the world as a whole by the orderly sequence in which they occur. A negative answer to this question is what is meant by the title of this book. There is nothing wrong in teaching that there has been a geological age, an age which can very easily be distinguished and set off from our modern age. This one geological age is a historical fact, it is the most securely established fact of the science of geology. But there is no reliable method of subdividing this geological age for the world as a whole. The fossil world, as we shall show, is a unit as to its age. And, in the light of the facts as we now know them, for any one still to keep on teaching the old time-distinctions among the fossils is nothing short of a hoax on the public. The evolutionary geologists have already made the world believe in their mystical ability to separate the fossils of one "age" from those of all others; but there is absolutely no scientific evidence on which to base this ability of discrimination. In fact, there never was the ghost of a good scientific reason for such assumed knowledge; and for any one still to keep on teaching this assumed supernatural knowledge of the past in the face of the evidence which we now have, is a hoax pure and simple. This is what we shall aim to demonstrate in the following chapters.

GEOLOGICAL CHART

| *Groups* | *Systems* | *Series* | *Types of Fossils* |
|---|---|---|---|
| Cenozoic | Quaternary | Pleistocene | Elephants and Other Mammals |
| | Tertiary | Pliocene<br>Miocene<br>Oligocene<br>Eocene | Many Extinct Mammals |
| Mesozoic | Cretaceous<br>Jurassic<br>Triassic | Upper Cretaceous<br>Lower Cretaceous (Comanchean) | Chalk, Dinosaurs,<br>Palms, Conifers |
| Paleozoic | Permian<br>Carboniferous<br>Devonian<br>Silurian<br>Ordovician<br>Cambrian | Pennsylvanian<br>Mississippian | Amphibians<br>Coal Beds<br>Insects<br>Crinoids<br>Fishes<br>Profuse Marine Invertebrates |
| Archæan or Primitive | | | Scanty Fossils or None |

This is but a brief outline of the chief geological divisions, each of the "Systems" and "Series" shown here being further subdivided into almost innumerable parts or "formations." Such a chart is usually read from the bottom upwards, to conform to the evolutionary theory that the Cambrian, etc., are always found at the bottom of the fossiliferous series all over the globe; which of course is not the case. This classification may still be retained as a useful though purely artificial arrangement, though we should always remember that these various subdivisions have absolutely no time-values.

I must assume that my readers are already somewhat familiar with the ordinary geological scheme of the successive "ages." A brief outline is given in the accompanying chart. If the reader is not already familiar with this geological "time-table," as it is sometimes called, he should make himself acquainted with it forthwith. The alternative will be that he must frequently refer to this table during the reading of the following chapters.

One fact of prime importance needs to be clearly understood here from the beginning. There is no place on earth where all or even nearly all of these "formations" are found together, one upon another. This table is the result of an elaborate system of piecework, and has been made by a purely artificial method of assembling separate findings from widely separated localities all over the world.

The table as given here does not by any means represent the more minute subdivisions of the geological time-scale; for each of the smaller subdivisions is again subdivided, then its divisions are again subdivided, until an enormous number of the final units found in all the various localities is thus represented. A few decades ago, it used to be said that the total thickness of the stratified rocks as then known was about twelve or fifteen miles. Now the total thickness is spoken of as sixty or seventy miles. But in any particular locality the actual thickness of the stratified beds found above the granite or the crystalline (unstratified) rocks, is from a few hundred feet to a very few thousand feet. Seldom do we find a thickness of more than five thousand feet; probably twice this amount may be regarded as the extreme limit in any particular locality, and this only in rare places here and there over the earth.

How then is the extreme figure of sixty miles obtained for the total of the stratified beds? Simply by adding the total thickness of the Cambrian in its " type region " with the totals of the various other groups of rocks in their type regions from all over the globe. In other words, this total is a purely artificial arrangement, made by grouping together into one series the extreme totals from many different regions all over the earth.

Nor do we ever find even samples of all these various sets of rocks together in any one vertical section. Sometimes we may find samples of three or four of them; usually it is only thin representatives of one or two, with perhaps a thicker sample of some other one. Only a very small fraction of what is listed as the total fossiliferous rocks is ever found in any particular locality. Usually the thickness is less than one mile. All of which tends to show the extreme artificiality of the geological classification taken as a whole.

The methods used by geologists in first studying any locality are sensible and scientific enough. The investigator of any new locality first observes the various strata, following them out as far as possible in all directions, and noting their physical relationships to each other. Fossils are especially sought for, and those beds which contain similar fossils or similar sets of fossils are grouped together into what is termed a *formation.* The relative age of the beds in this locality is determined by the principle of *superposition;* for it is self-evident that the beds at the bottom must have been deposited before the ones above them.

When the one or more formations in this locality have been followed out in every direction as far as possible, and when the fossil contents of all have been determined, names will be given to the various formations represented, these names being based on local geographical names, and the various beds being designated in some manner as is most convenient. But these names have at first only a local or notebook value, until the fossils which they contain have been carefully compared with what are regarded as the standard fossils from other regions. Perhaps some of the fossils happen to be trilobites; these will be compared with the standard lists of trilobites, and after due consideration these beds will be assigned to a definite pigeonhole in the big geological "time-table," being said (let us suppose) to be equivalent to certain beds in England or Norway or Alberta. If the fossils here found happen to be considerably different from any particular assemblage found elsewhere, these beds may have to be classed as being "intermediate" between other well-known beds in the standard or typical localities.

The finding of one or two "index fossils" in any new locality will be treated as settling the exact "age" of the rocks in which they are found, though these rocks may be thousands of miles away from any other rocks containing similar fossils. And this method of making the fossils decide the "age" of the rock in which they occur is followed out with grim consistency. *For the fossils alone determine the "age" of the rocks, no matter what the rocks look like, no matter whether they are hard or soft, and no matter what other kinds of rocks may be above them or below them.* When the fossils happen to be found in the "wrong" order, or the reverse of the " standard " order, the rule of the fossils is still adhered to; and geologists will solemnly assure us that the upper beds have been somehow lifted up and pushed over into their present position, thus producing what is termed a " thrust fault," even though the beds look perfectly natural. Typical "index fossils " are always regarded as the very last word in such matters, and all other evidence whatsoever is disregarded or brushed aside, when it comes to assigning the beds to their appropriate pigeonholes in the great geological " time-table."

The question naturally arises at this point, How and when did the early geologists construct this elaborate fossil index, or the " time-table " for the world as a whole? In other works by the present writer this matter of the early history of the science has been quite fully examined. It has there been shown that this system of treating the fossils as true keys to the age of the world in which the various rocks were deposited, grew up very gradually and unthinkingly, the pioneers merely following the local phenomena in the field, and uncritically assuming that these local phenomena must apply to the world as a whole.

Many have been the criticisms levelled at the whirligig reasoning thus exhibited. Spencer wrote an essay entitled *Illogical Geology,* and Huxley declared that " Not proven and not provable " must be pronounced against all the larger theories regarding the succession of life for the world as a whole. One of the keenest criticisms along this line was made not long ago by Dr. Johannes Walther, professor in the University of Halle, Germany. " We have indeed," he says, " been reasoning in a circle when we attempted to correlate the strata of the earth by their contained index fossils, and then inferred the time-value of these particular species of fossils from their occurrence in rocks of the same age." But in spite of all such criticisms the methods still prevail. No doubt the present anomalous situation in this science has come about because of the undue specialization of most students of the rocks. Each one is so intently occupied with some particular local problem that he seems quite oblivious of the logic of the science as a whole. And these particular specialists, most admirable men as they are personally, always rise up in wrath against any one like the present writer who presumes to intrude upon their work and tell them that they are reasoning illogically regarding the phenomena of geology as a whole.

But the mills of the logic of science have a fashion of grinding exceedingly fine, even though they may grind with great slowness. And although all the professional geologists and palæontologists always resent any criticism of their methods by what they term "outsiders," there is gradually growing up a solid body of intelligent opinion among those who have had some training in logical methods, and who will not continue much longer to accord the label "scientific" to methods so utterly contrary to the most elementary principles of logic.

In any particular locality, of course, the beds at the bottom must have been deposited before the ones above them. This is the law of superposition, and of course is strictly scientific. The lower ones were deposited before the ones above them; but how long before? Was the first bed laid down ten minutes before the next one above it, or ten millions of years before? To be strictly accurate and careful, as is necessary in this instance, we must say that there are physical evidences to be observed at the plane of contact between any two successive beds, by which we may usually determine that the upper surface of the lower bed was still soft and entirely undisturbed when the next layer was placed upon it. Such a condition is known as *conformity;* the upper bed is said to be *conformable* to the lower one. And common sense tells us that in true conformity the beds must have followed each other somewhat quickly. In other words, conformity means almost continuous deposition, just enough of an interval or change of conditions to make two beds instead of one continuous bed.

In the early days of the science, under the leadership of A. G. Werner, the observed succession of the rocks as found in Saxony, Germany, was assumed to be of world-wide application. It was uncritically assumed that the particular sequence of the rocks observed there would be found true also for all the rest of the world. This theory became known as the "onion-coat theory." It was based on an elaborate set of "index minerals," just as we now have a very elaborate set of "index fossils," the minerals being used then just as the fossils are being used today, to date the rocks in which they were found. And it is an amusing fact that for about half a century all scientists, even in far distant lands, as Mexico, India, Russia, or the United States, always thought they found the granites, schists, limestones, sandstones, etc., occurring in the same relative sequence as Werner had taught was the true historical order.

Of course, the trouble with such a theory is that it is making the local sequence the infallible standard for all the world. Such a theory could only be true if there were really globe-enveloping layers like the coats of an onion, which could be physically traced out in the same relative position all over the globe. It was a childish conception, suited to the infancy of the science. The pity and the shame is that, as Herbert Spencer declared, " though the onion-coat hypothesis is dead, its spirit is traceable, under a transcendental form, even in the conclusions of its antagonists."

Werner's onion-coat theory, based on his precious " index minerals," was only discarded after many visible contradictions of his standard order had been discovered in many localities. But gradually and almost imperceptibly geologists changed their standards of comparison, and fixed on certain fossils as always characteristic of certain ages in the history of the world; and thenceforth tabulated the stratified rocks of the world by the kinds of fossils found in them. And these methods still prevail. Modern geologists have simply substituted " index fossils " for the old " index minerals " of Werner; but the logic (or rather the lack of logic) is the same in either case.

The details of this amusing history have been given with almost tiresome reiteration in the many books which the present writer has written on this subject. I would particularly refer the reader to *A History of Some Scientific Blunders* (1930), where full details are given regarding such men as Werner and " Strata " Smith, who started the world along the lines of supposedly scientific study of the rocks. This history is an amusing record of how local rule-of-thumb methods, as used by miners and ignorant rustics, were naïvely and unquestioningly adopted by all the students of geology, and by them taught to the rest of the world for just as reliable science as the methods employed in physics or chemistry or astronomy. The establishment of geological surveys by all civilized countries about a hundred years ago set the seal of government approval upon the infant science which had not yet shaken off its crude methods; and this financial and scholastic recognition of the geological theories of that day has made it impossible to obtain any reform in the methods of reasoning then prevailing.

In this manner, and without any critical examination of the logical fallacies involved, the geological surveys of all the civilized lands, with the prestige of the various governments behind them, have taught the world this scheme of successive geological "ages," each "age" (it was said) having been characterized by some particular group of plants and animals. And accordingly now, whenever we find any of these characteristic kinds of life in the rocks, we can always without further question assign these rocks to a definite period in the world's history. Fossils used in this way to date the rocks in which they occur are termed "index fossils," just as Werner dated the rocks in his day by his "index minerals."

Let us now try to answer the question, Which are the oldest fossils?

Although a few deposits have been found here and there which are said to be even older, the Cambrian beds are the standard for the oldest stratified rocks anywhere on earth. They occur in British Columbia, Newfoundland, Wales, New York State, and in many other scattered localities. Of course, they rest on the granite or on other crystalline non-fossiliferous rocks. They are undoubtedly the oldest stratified beds in their respective localities. The question now is, Are they of world-significance as to age? or are they merely local phenomena, with other very dissimilar beds (or beds containing distinctly different fossils) in the very same physical situation elsewhere, and thus in a position where no one can affirm that they were not all contemporaneous?

The characteristic Cambrian fossils comprise special kinds of trilobites, crinoids, annelids (or jointed worms), brachiopods, graptolites, gastropods, corals, and sponges. As Austin H. Clark has pointed out, all the phyla or major groups of the animals (except the vertebrates) are thus represented in these supposedly oldest rocks; and these Cambrian fossils are as distinct and as well formed as the modern representatives of these same groups. Clark says that all these major groups must have originated simultaneously at the very beginning of life on the globe. It certainly looks like a simultaneous beginning of all these great groups, when we find representatives of all but the vertebrates in these rocks which are supposed to be the oldest rocks on earth.

But several facts need to be considered before we decide that these Cambrian fossils represent *all* the kinds of life anywhere existing around the globe at the time when these deposits were formed.

1. In the first place, these Cambrian beds are not found everywhere. They seem to be about the smallest and least widespread of any of the great systems or sets of fossil-bearing rocks. They are not nearly so widespread as the Carboniferous or the Cretaceous.

2. In some localities, as in Wisconsin and to the east of the Baltic Sea, typical Cambrian beds occur which are still soft and unconsolidated. They consist of clays, sands, gravels as soft and unconsolidated as

if they had been laid down last year. They are, however, undoubtedly Cambrian, for they contain typical Cambrian trilobites, brachiopods, etc.; and fossil evidence is always considered superior to every other kind of evidence whatever.

3. In other localities and over wide areas, very different kinds of rocks (that is, rocks containing very different fossils) are found in this same bottom position; that is, they likewise occur directly upon the granite or the Primitive rocks.

In California the Tertiary beds lie directly upon the granites and gneisses, and are as hard and as old-looking as any fossiliferous rocks on earth. Throughout Tennessee, eastern Mississippi, and into Alabama, the Cretaceous beds rest directly on the very old rocks, and in Georgia they lie on the old Primitives. Over much of the Great Plains and the Rocky Mountain regions the Carboniferous rests on the Primitive or Archæan. In Cuba and Jamaica the Cretaceous beds lie directly upon the Primitive; while through much of Germany this is the ordinary position of the Mesozoic rocks; and it was on this account that they were formerly called "Secondary." Examples of a similar sort might be given from all over the globe.

Clearly there is no possible way of proving that these Carboniferous animals and plants of the Great Plains Region were not contemporary with the Cambrian animals in their respective localities. Similarly we have a perfect right to say that the Cambrian were also contemporary with the Tertiary fossil forms in California and with the Cretaceous in the South Eastern States, and so on with the other formations elsewhere.

Which, then, are the oldest fossils?

All persons who wish to think clearly must try to preserve a clear distinction between the methods used in gathering the facts of a science, and the methods of reasoning by which we seek to " explain " these facts or set them into proper relationship to other facts either in the same science or in other departments of knowledge.

For instance, in any particular locality it may be convenient for us to begin at the bottom of a set of beds, and trace the order of superposition upward. Whether we begin at the bottom and count upward, or begin at the top and count downward, will be just a matter of convenience. It will make no difference in the final number, nor in their relationship with each other. But it is important for us to remember that in all this enumeration of beds and their physical and fossil relationship to one another, we are *dealing only with local phenomena.* It will never do for us to assume that these strata will always be found in this same relative sequence around on the other side of the globe, unless we are prepared to defend the old onion-coat theory of absolutely universal envelopes around the entire earth.

In other words, the methodology under which we gather all the facts about local field conditions, must not be confused with the philosophical explanation necessary for us to understand the relationship of these facts to the other facts. The gathering of facts must necessarily be fragmentary and local; the " explanation " must just as necessarily be philosophical and universal. It is a sad slip in logic, an utter confusion in thinking, to allow the one to pass for the other, or to say that the methods of the one will be the same as the methods of the other.

Again let us ask ourselves the question, Which are the oldest fossils?

In the light of the facts given in the preceding paragraphs it is self-evident that no fact or set of facts known to us can justify us in saying that the kinds of life which we call Cambrian must have actually lived and died before those which we class as Carboniferous, or that the Cretaceous forms of life lived before the Tertiary, or indeed any of these before any of the others. Unless we are to dispense with strict logic in these first steps of the science of geology, we must admit that we can never prove the Cambrian forms of life to be a day older than all those many other groups which are often found in the same bottom position.

It is no argument to say that the species of the Cambrian are all extinct. Even if this were true, the same is asserted of the fossils of most of the other systems; and how can one group be *more* extinct than another? But this assertion is not true. Several species very characteristic of the Cambrian and long classed as " extinct " have exactly similar representatives living in our modern oceans in comparative abundance. To make the matter even worse for the old theory, the fossil kinds and the living kinds occur side by side. For instance, on the shores of the Gulf of St. Lawrence are Cambrian rocks containing fossil *Lingulas,* a kind of brachiopod; while in the water at the base of the very same cliff are the living species of the same animal, and the two cannot be distinguished as to species by even the most finical and arbitrary tests. Since Lyell argued the modern character of the fossils in the Appenines, because exactly similar kinds are found alive in the Mediterranean near by, why may we not just as reasonably argue for the modernity of these Cambrian beds?

From the facts given above it is self-evident that we cannot begin at the bottom of the fossiliferous series and work upwards, in seeking to trace a world-chronology; for there really is no such thing as a real bottom among the fossils. *There are no bottom fossils for the world as a whole;* any and all of them are found occurring at the bottom quite indifferently. It was only a big blunder in Sedgwick and Murchison and the other early explorers to think that the bottom rocks in Wales or Scotland would always be found all over the bottom of the stratified rocks all around the world. If we ever hope to work out a chronological scheme for the fossils of the world, it must be by some other method than that hitherto employed.

As suggested in a previous chapter, it may still be possible to determine something about the fossils as a whole. But the only scientific method, the only method at all likely to give secure results, would be to start with the present order of things and then try as best we can to work backwards into the past. This would mean that we must begin with the surface phenomena, or those geological phenomena closest to our modern conditions, and must then work downwards into still older strata. This would be the only scientific method; but it might not get us very far, and it is quite unlikely that it would ever yield us reliable distinctions among the fossils which would give us anything like a chronology for the world as a whole,—certainly not, if a great world-catastrophe has intervened between that ancient world and our own.

But this point must be postponed for the present.

We have not yet examined sufficient data to decide all these matters.

Our next study will be of the many examples where we have strict conformity between beds said to be many millions of years apart, that is, where very " young " beds are found resting in perfect conformity upon beds classed as many " ages " older, with nothing to show for all the great space of time alleged to have intervened.

## V

## MISSING AGES

OUR next indictment of the geological-ages theory grows naturally out of the facts about conformity, as explained in the preceding chapter. When one bed lies upon another directly, with no physical evidence that the lower one was disturbed in any way before the upper one was laid upon it, and with no sign of any erosion of the upper surface of the lower one before the next was deposited, the two beds are said to be *conformable.* In such a case the two beds obviously followed each other in almost quick succession. There is a slight interval, to be sure, else there would have been one bed, not two. But the time interval between them was short; for true conformity means essential continuity of deposition.

Now it is a very interesting fact that very " young " beds often occur in real conformity upon beds classed as very much older, all the alleged intervening " ages " being entirely missing. Here is another argument for the unity of the fossil world, and a very conclusive argument against the reality of these alleged " ages."

An example of this sort is called a " deceptive conformity," and very properly so. The meaning is that the case looks exactly like a true conformity; but the advocates of the popular theory of successive ages declare that the rocks are deceiving us,—they declare that they *know* it cannot be a true conformity, for many of their familiar " ages " are here missing. They tell us that in the geological " time-table " the systems represented by these two successive beds are many " ages " apart, hence (they argue) these two beds cannot have been deposited in direct succession, it is only a deceptive appearance of conformity. In other words, they " know " better than the rocks themselves. They have the audacity to give the lie to the rocks on the strength of their traditional theory.

Let us note a few specific examples.

Around Lake Athabaska, Canada, Cretaceous rocks occur conformably on Devonian, all the Carboniferous, Permian, Triassic, and Jurassic being missing. This example is several hundred miles in area each way, comprising nobody knows how many tens of thousands of square miles. It is rare that even the most honest conformity is so widespread. Yet we are asked to believe that over all this vast district there was absolutely nothing going on during the Carboniferous, Permian, Triassic, and Jurassic " ages," nothing in the way of either deposition or erosion. In plain common sense, apart from any theory, all these alleged " ages " never existed in this locality. No other interpretation is possible, unless we make a mere theory of more importance than objective facts.

Another example occurs near Banff, Alberta. And it is so picturesquely described by a former Director of the Canadian Geological Survey that I cannot do better than to quote his words. He tells us that the Lower Cretaceous overlies the Lower Carboniferous, the Middle and Upper Carboniferous, the Permian, the Triassic, and the Jurassic being missing. But these age-separated formations follow one another " without any perceptible break; and the separation of the one from the other is rendered more difficult by the fact that the upper beds of the Carboniferous are lithologically almost precisely like those of the Cretaceous" [above them]. And he adds: "Were it not for fossil evidence, one would naturally suppose that a single formation was being dealt with."

Near Louisville, Kentucky, Middle Devonian *coral limestones* occur conformably on *exactly similar coral limestones* of the Middle Silurian; and Schuchert is our authority for the statement that "the parting between these two zones is like that between any two limestone beds," although according to the theory the interval here *un*represented in any way must have been several million years.

Great numbers of such instances might be cited from various parts of North America or Europe. Several instances have become historic, where strata were at first classed as one formation by experienced geologists, but afterwards had to be widely separated into two distinct systems because of the fossils found in them. Thus in China, throughout the four northeastern Provinces, beds now classed as Upper Carboniferous rest in perfect conformity upon Lower Ordovician beds, the rest of the Ordovician, all of the Silurian, all of the Devonian, and much of the Carboniferous being missing; although Richthofen, when he first discovered them, classed them as one formation.

I need not list any more specific examples. Many of the leading writers have remarked on the strange fact that entire geological "ages," sometimes many of them in a single vertical section, can thus be unrepresented either by deposition or erosion over wide tracts of the earth's surface. But in no single instance that I have read of has the suspicion arisen that these alleged "ages" cannot have existed in these localities.

A generation ago Darwin spoke of the " many cases on record " of this sort. Sir A. Geikie, for so many years the head of the British Geological Survey, admitted that " it is not so easy to give a satisfactory account " of examples like this, " where the strata are strictly conformable," and where there is no physical evidence of any change in the lower bed before the next one was deposited upon it. But he admits that these examples of " ages " unaccountably missing are " not merely local, but persistent over wide areas. . . . They occur abundantly among the European Palæozoic and Secondary rocks," and are " traceable over wide regions." I remember hearing one of the most experienced men connected with the United States Geological Survey remark that he had probably seen a thousand instances of this sort, some of them covering areas equal to one or more States.

Eduard Suess has said that in instances such as we have been describing, where the upper bed is perfectly conformable to the lower, " so that the stratigraphical relations offer no hint of the great gap which occurs at the line of contact," such facts " may well be cause for astonishment." However, I am afraid that many of my readers will rather have cause for astonishment that educated and otherwise sensible men cannot see the obvious conclusion to be adduced from such facts.

Dr. E. O. Ulrich, in discussing such phenomena, says:

" It makes little difference whether the compared sequences are *lithologically similar or dissimilar;* the large hiatuses are, as a rule, no more clearly defined than the small breaks."

From all this testimony, which might be multiplied indefinitely, it ought to be clear that in these instances of " deceptive conformity " the strata must have followed like those of any other conformity, in rapid succession. These phenomena are " deceptive " to those only who have a preconceived theory which is thus contradicted. Such instances *are real conformities, not deceptive.* We ought to play square with the rocks, and not charge them with trying to deceive us; we ought to take the rocky testimony at its face value. What scientific justification can we plead for clinging to a metaphysical theory in the face of objective evidence which so squarely contradicts it? Huxley used to say that the man of science had learned to trust to justification, not by faith in a theory, but by verification of the facts. Obviously men of science stultify themselves when they are so hypnotized by a theory invented by the ignorant pioneers a hundred years ago, that when they meet with examples where the rocks contradict it, they can only say that the rocks are deceiving us.

Clearly enough, in all such instances, we ought to admit that these conformable beds must have followed each other in reasonably quick succession. When we find a Cretaceous conformably on a Devonian, the only sensible thing to say would be that, in this particular region, there happened to be no floras or faunas living contemporaneously which we now call Carboniferous, Permian, Triassic, and Jurassic, but that the Cretaceous forms of life were either very closely successive to the Devonian or actually contemporary with them. When Cretaceous occurs directly on Carboniferous, the Permian, the Triassic, and the Jurassic were not represented in this vicinity; and so the beds containing oysters, chalk, and dinosaurs could be laid down conformably upon the marine limestones of the Lower

Carboniferous, as in the instance quoted above. We might go on in this way all around the world, running the entire gamut of the possible combinations of any two or three formations; for in any particular locality it is usually only two or three systems which are found represented.

We may conclude this chapter by saying that these numerous examples of "deceptive conformity" constitute splendid proof that the many millions of years alleged to have passed between the laying down of the two successive beds concerned never really existed at all in these localities; and if they did not exist here, the implication is clear that the missing floras and faunas do not represent real "ages" anywhere else.

In one of the following chapters we shall consider examples directly the reverse of these, namely, where alleged "old" rocks (or old floras and faunas) are found in just as obvious conformity upon other rocks classed (because of their fossils) as millions of years "younger."

To such lengths of absurdity have our scientists been driven by following a metaphysical theory instead of objective facts.

## VI

## SKIPPING MANY AGES

ONE of the blunders connected with the evolutionary interpretation of the rocks relates to the theory of "extinct species." It is a large subject, and one that is not easy to explain in non-technical language. But I must make the attempt.

The early geologists thought that they were dealing with a sort of fairy world, one having little or no connection with the world in which we now live. For they asserted that all the fossil plants and animals without exception belonged to kinds wholly different from the modern ones. All the fossils, they said, belong to extinct species. This idea has probably come to the world chiefly through Baron Cuvier, that strange genius who originated so many lines of scientific study, and passed them on to us so strongly stamped with his own peculiar theories that it has taken the world over a hundred years to shake off some of them.

Charles Lyell inherited this prejudice about "extinct species." But with him the idea became somewhat transformed. He was largely interested in shells, above all in the shells found in the rocks which we now call the Tertiary formations, which are the surface rocks over a large part of Europe. Lyell was the one who first undertook to subdivide these Tertiary beds and to tabulate them off in the accustomed chronological order for the entire surface of the earth. He gave us the names "Eocene," "Miocene," and "Pliocene," basing these subdivisions of the Tertiary on the percentage of living and " extinct " Mollusca which he found occurring in the many individual beds scattered over Europe and America. Those beds in which the fossil mollusks were considered to be about all " extinct " were classed as " Eocene;" those in which the fossil shells were considered to be about all like those still living in the neighbouring waters were called " Pliocene;" while the name " Miocene " was given to those beds containing about fifty-fifty " extinct " and " living " kinds.

It will probably be believed without much argument on my part that, in the course of the hundred years which have elapsed since Lyell first issued his *Principles of Geology,* we have discovered many living examples of species which Lyell thought were extinct. Nevertheless, the methods which he then initiated are still with us; and beds newly discovered in Alaska, or Sumatra, or Timbuktu are still given names based on this system of " extinct " and " living " shells which they happen to contain, though in actual practice other fossils besides the mollusks are also now usually taken into consideration.

This idea of a gradual approximation to the modern conditions is one that at first sight seems eminently reasonable. If in this fourth decade of the twentieth century we could feel as *sure* of the general doctrine of Uniformity as Lyell felt a hundred years ago, it might not be so bad an idea to arrange the surface rocks of the world off on this percentage system. That is, *if* we could still feel absolutely certain that some great world-cataclysm has *not* intervened between that fossil world and our own. But if some such world-catastrophe really did occur, and all the plants and animals had to run the gantlet of such a wholesale destruction, our modern living species being simply the lucky survivors while all the others perished, *what possible scientific value would attach to a percentage system, such as Lyell's?* If geologists don't see that they are thus begging the entire question of how the fossils were buried in the long ago, everybody else does.

Accordingly, Lyell's method (the method still in use all over the world) will be of no use to us in making a real scientific investigation of the rocks. For our chief problem is, *How did the fossils become buried?* If we profess that we are out for the truth, and are making an honest scientific investigation, it will never do to assume the entire answer to this question, as Lyell did, and then arrange all the facts of the rocks so as to fit this assumption, as has been done ever since.

Lyell, too, decided this momentous question without one percent of the evidence which we now have. And unless we are prepared to follow blindly in his steps, as the whole world has done ever since, we can never attach the slightest time-values to his various subdivisions of the Tertiary system, though we may retain the names he gave them, if we can always remember that such names as Eocene and Miocene and Pliocene are mere classification labels and have absolutely no time-values. In other words, we cannot be at all certain that the Eocene beds are any older than the Pliocene, or even than many beds classed as Pleistocene. In any particular locality, of course, we can apply the rule of superposition; but in the light of what has been said above, it would be folly for us to attach any time-significance to the Eocene or Miocene or Pliocene strata of the world as a whole.

This brief discussion of "extinct" and "living" species is but introductory to the main topic of this chapter, which is that many kinds of animals and plants found as fossils in England or Germany or America, and long thought to be completely extinct, have since been discovered living today in some other locality, perhaps on the other side of the globe. The modern kinds may be in comparative abundance, perhaps in great numbers. And such examples are by no means confined to the Tertiary fossils. In many cases the living kinds are the duplicates of fossils found only in the Mesozoic, perhaps even in the Palæozoic group. In such instances we have the awkward situation of being obliged to say that these kinds have skipped all the intervening formations down to the modern. The fossils, let us say, occur in the Devonian or the Triassic of America or England; the modern forms are found in the Southern Pacific or the Indian Ocean; but there is not the slightest trace of these in the fossil form in any of the supposedly more " recent " systems of rocks. This we must regard as another grave objection to the alleged time-values of these various groups of the stratified rocks.

That versatile genius Edward Forbes was one of the first to discover living specimens of sea animals which had long been thought to be found only in the fossil form. This occurred in his dredging in the Ægean Sea in 1841–1842. Various other shallow seas were dredged subsequently from time to time; but it was not until the time of the *Challenger* Expedition (1872–1876) that scientists knew anything but guesswork about the life or the physical conditions existing at the bottoms of the deep oceans. From that day on to our own many governments and scientific societies have joined in the toilsome and expensive work of examining the depths of the oceans, until it may be said that we are now beginning to have a fairly intelligent knowledge of the kinds of life in the deeper waters and the physical conditions there prevailing.

The result has been that most of the notions regarding these matters held by Lyell and the founders of geological science have had to be revolutionized. The entire absence of currents in the deep waters was one of the surprises of the *Challenger* and other subsequent expeditions; and this fact has a very important bearing upon our theories of how the animals from the deep seas could ever get buried in beds of sand or clay, or how they could ever become interbedded with land plants, as we find is so frequently the case in the Carboniferous and other formations. But the discovery of many forms of life, hitherto known only as fossils, but still living in thriving abundance at the bottom of the oceans, was also among the surprising facts revealed by these explorations of the ocean depths.

The examples of fossils which either skip one or more of the geological "ages," or which skip all the "subsequent" formations from the Palæozoic or the Mesozoic down to the modern, run into the hundreds or the thousands. So it will not be possible to do more than touch briefly on the subject here. A few brief generalized statements must suffice.

The brachiopods or lamp-shells may be good ones to start with. The four great groups or families of these animals, the *Cranias*, the *Lingulas*, the *Discinas*, and the *Rhynchonellas*, all occur plentifully as fossils in the Palæozoic rocks, many of them being regarded as splendid "index fossils," and all have many representatives in our modern oceans. But practically all of them skip the whole of the Tertiary and the Pleistocene formations, while all but the fourth group are missing from the Mesozoic as well. And when we compare the fossil shells with the modern ones it takes a finicking expert to tell them apart.

Essentially the same story can be told of the stalked crinoids, or sea-lilies. Many of the great limestones of this country and others are composed largely of the fossil remains of ancient crinoids; and yet the accepted arrangement of the rocks into successive "ages" makes it appear that these animals have skipped from the Mesozoic to the modern, some of them even skipping much longer periods.

The Mollusca represent many very diversified kinds of animals; and no such generalized statement would be possible about the phylum as a whole. Yet among them are many important families, such as the *Trigonias,* the *Pleurotomarias,* etc., which have skipped from the Mesozoic to the modern, some of them from the Palæozoic.

As I have intimated, these absurdities are due solely to the traditional methods of arranging the ancient floras and faunas in a long series of allegedly successive "ages;" when in reality all these forms undoubtedly lived contemporaneous with each other. But the accepted arrangement into a serial order makes it appear that almost all of those which survive have skipped one or more of these artificial "ages," representing often many millions of years.

The land snails are thus made to skip the Permian, Triassic, and Jurassic "ages." The scorpions skip the Devonian, while the scorpions and the spiders (the Arachnida) are made to skip the Permian, Triassic, Jurassic, and Cretaceous. The entire class of the Amphibia are in this manner made to skip the Jurassic, the Cretaceous, and the Eocene. Very many of the vertebrate fishes similarly appear to perform great feats of time-acrobatics, these absurd conditions being entirely due to the method of arranging the fossils in an allegedly chronological order, some of them in one " age " and some in another.

In the early days of the science, when geologists supposed that they were dealing with a sort of phantom world, in which all the kinds were absolutely extinct, it did not make much difference in what order the fossils were arranged. Now, however, these time-arrangements are developing all kinds of absurdities, because so many of the fossil kinds of both animals and plants are found to be identical with kinds still living in our modern world. It is by no means a phantom or a fairy world with which we are dealing when we examine the fossils in the rocks, but simply an older state of our present world. And all these difficulties or absurdities would never exist for a moment, if we should reorganize the entire theoretical aspects of the science, and begin a strictly heuristic study of the entire fossil world according to the methods outlined in some of the previous pages, by working from the present floras and faunas backwards into the past.

These facts about " skipping " indicate that there must be something wrong with the arrangement of the fossils which produces such absurd results. But they also suggest that there must be something wrong with the mentality of the men who could keep on facing such facts as these for a lifetime, and still have no secret doubts about the real validity of the time-values attaching to such names as Cambrian, Silurian, Cretaceous, or Tertiary.

However, it is almost impossible to overestimate the power which a theory possesses over the minds of men, after it has been held unquestioningly for one or more generations. It seems to paralyze the reasoning faculties, and often hypnotizes its followers into doing almost any strange logical antic. The history of natural science is replete with examples which would be amusing if they were not so piteous. Geology is not particularly worse than other sciences in this respect, except for the fact that all the other sciences outgrew their speculative childhood centuries ago; while geology seems to have been subjected to arrested development, and has not yet outgrown its speculative stage. Thus we still have these amusing examples of unscientific methods surviving in the geology of this twentieth century, whereas in the other sciences such queer logical antics, due to the hypnotism of a traditional theory, are known to us chiefly from the history of the Middle Ages and before.

In the next chapter we are to study those instances where the " ages " are found in the field in the reverse order. But the geologists have learned their little " time-table " so completely by heart that they are prepared to give the lie to the rocks even more boldly than in the case of " deceptive conformities." They seem to have entirely forgotten what Huxley used to say is the chief lesson learned by science, " to give up pretending to believe that for which there is no evidence." For in order to save their " time-table " intact, the fearless followers of Lyell and Cuvier have invented incredible fairy stories about immense mountain masses having been pushed many miles across soft shales or limestones without injuring them in the slightest degree.

## VII

## REVERSING THE AGES

SOME of our ultramodern physicists are seriously discussing the problem of whether time may not be a reversible process. May not all the phenomena of time be capable of being reversed and everything done over again backwards?

The disciples of Lyell ought to take a hint from the physicists. For when they get into perplexity by finding the important index fossils in the reverse of the "standard" or supposedly "invariable" order, they have hitherto adopted the inept expedient of saying that there must be a fault somewhere in the rocks (not in the theory), whereby the "old" rocks have somehow been raised up and pushed over onto the "younger" ones, where we now find them looking perfectly natural.

Are the fossils invariably found in a certain sequence? Yes,—except when they are found in some other order. An "invariable" order with almost innumerable exceptions, and with plenty of examples of almost every other possible order, is it? What a travesty on the scientific method to take this supposedly "invariable" order of the fossils as an absolutely certain index of the various successive "ages" which our world has passed through. And yet some clergymen who loudly boast of their "Fundamentalism" now find themselves in the stultifying position of trying to harmonize the "days" of Creation mentioned in Genesis with this traditional order of the fossils, in spite of all its twistings and uncertainties. One might as well try to steer a ship by a weathercock.

Do the fossils invariably occur in the same relative sequence? Hardly. As Marius R. Campbell, Principal Geologist of the United States Geological Survey, recently wrote in a letter to the present writer, the reverse order is " now recognized as being of very common occurrence, but because of the apparent conformity of the overthrust mass and the rocks upon which it rests, such phenomena have in the past been incorrectly interpreted."

In other words, those who first examined and reported on these various cases thought that the rocks had of course been laid down as we find them. But afterwards, when it was discovered that the fossils were in the reverse of the " invariable " order, they and their fellow geologists had to invent the theory of thrust faults, and say that the " older " rocks must have been lifted up and pushed over bodily on top of the much " younger " ones, in order to save the reputation of their " invariable " world time-table.

And yet such juggling with the facts and the evidence still passes as perfectly respectable science in certain circles. Would such methods be tolerated in chemistry, or physics, or astronomy? Why, the man who was caught employing such juggling with the evidence in any of the other sciences would soon be hooted out of scientific circles. But why are such methods still openly and persistently followed in geology? It is very humiliating to have to confess that these methods are tolerated just because they have long been universally practised. Are we to think of theoretical geology as a sort of magic wonderland, in which the mere act of repeating a formula over three times makes it “ so ”?

When examples were first found in the Alps of the fossils in the “ wrong ” order, the theory of huge folds in the rocks was invented. After many years of field observation and discussion it was decided that these great folds were incredible and impossible,—for one thing, because no physical evidence for such folds could be found.

Then the theory of a sharp break and a flat-lying thrust fault was substituted. Such a theory was supposed to be especially suitable for cases like the great area in Alberta and Montana, where the strata are all approximately horizontal, and where so many thousands of square miles of area are involved. It almost shocked even hardened geological speculators to be told that a strip of country over five hundred miles long and from thirty to sixty miles wide had been lifted up several miles and had been flopped over on itself like a big pancake. For throughout all this vast region, embracing the entire Glacier National Park, and extending across the Canadian border away up north to the Yellowhead Pass in Alberta, the strata are in general quite horizontal and perfectly natural looking. Accordingly, instead of an overthrust fold, the theory of a flat-lying thrust from the west has been adopted, and is now the recognized explanation of how these Palæozoic limestones and quartzites happen to be found resting in a horizontal position on the soft Cretaceous shales.

There are two leading difficulties with this explanation.

One is the physical evidence. Over all this area there is very little sign of disturbance, though no area of this size is ever free from some tilting of the rocks. The beds in nearly all the mountains are still horizontal, and they have been carved out by erosion and left standing in colossal cathedral-like masses two or more miles above sea level. These mountains are all clearly mountains of erosion, as obviously erosion remnants as any mountains anywhere. At several dozen places throughout this vast region the contact line between the upper hard limestones and quartzites (Palæozoic) and the underlying soft shales of the Cretaceous is easily examined; and in all of these places the outcrops look exactly like the perfectly normal sequence of two nearly horizontal formations. Somebody hunted around until he says he found an example of slickensides at the base of one of the mountains here involved. But such a thing proves nothing in defence of the theory of a gigantic thrust fault; for it is not difficult to find a local condition showing slickensides in almost any area, even where no such earth-movement has taken place.

The plain and convincing fact is that dozens of the most experienced field geologists of all lands have now examined this area, and the uniform testimony is that the strata look perfectly natural, they have every physical appearance of having been actually laid down in the order in which we now find them. In other words, the physical evidence is all against there ever having been any such pushing of these huge mountains for fifty or sixty miles across these soft, seemingly-undisturbed shales. But the tradition of an invariable order of the fossils demands something desperate in the way of an explanation; and so the geologists all follow meekly like sheep, and say that of course there must have been an overthrust, for otherwise how did all these Palæozoic strata get out of their " normal " position and over on top of these Cretaceous beds?

Professor W. W. Watts, one of the leading geologists of England, makes the following enlightening remarks:

> " The problem of the overthrust ' nappes ' of mountain regions is one of our greatest difficulties, and all explanations hitherto proposed are so hopelessly inadequate that we have sometimes felt compelled to doubt whether the facts really are as stated. But the phenomena have now been observed so carefully and in so many districts that any real doubt as to the facts is out of the question, and we must still look for some adequate method by which the overthrusting could have been brought about." (*Annual Report of the Smithsonian Institution,* 1925; pp. 283-284.)

The second difficulty is concerned with the logic of the situation. Why is geology alone of all the sciences accustomed to dispense with logic and common sense, when dealing with the events of the earth's long-gone past?

We first have a certain relative sequence of the fossils which we have grown accustomed to finding in Europe and the eastern part of America, and we call this the standard or the " invariable " sequence. There really is no earthly reason for expecting that we must always find the fossils in this order, except that the early pioneers taught their pupils to look for this order, and people usually find what they are looking for.

But now we find numerous instances where the fossils are obviously in the reverse order. And some of these areas are as large and as unambiguous as any hitherto discovered with the fossils in the first order. The strata look as if in a perfectly normal sequence, as if they were deposited just as we find them. Why should we feel at liberty to tell these rocks that they are lying to us, and that we know they could not have been deposited as we find them, when our only reason for such an assertion (aside from an evolutionary prejudice) is that we have been accustomed to another order? Why should the dead hand of tradition be allowed to dictate to us the kind and quality of the discoveries that we shall be allowed to make in the future? The geological sequence of the fossils in England and Germany was the first set of facts which suggested the theory of organic evolution. Is this theory of evolution now grown so strong that it can dispense with the geological outline, and even contradict it?

Are we not supposed to be making a scientific investigation? Obviously the rocks are wrong, or the theory of evolution is wrong. But why should we not believe the rocks rather than the theory?

The plain and indisputable fact is that there is no logic and no scientific justification for not taking these examples in the Alps, in Alberta and Montana, and in the hundreds of similar localities, at their full face value. *These rocks were obviously deposited in the order in which we find them.* Let us see what consequences follow, if we accept these phenomena as we find them. And let us remember the stern admonition of Huxley that the foundation for scientific morality "is to have done, once for all, with lying; to give up pretending to believe that for which there is no evidence."

We must now say that throughout this Alberta-Montana area the Cretaceous fossils were deposited before the Palæozoic. This means that throughout this large region the dinosaurs and the chalk and the cycads and conifers of the thick coal beds were deposited *before* the trilobites and the graptolites. But elsewhere the latter were laid down first. From this it inevitably follows that all these diverse types of life must have been living together in the same world, that is, living contemporaneously. No other conclusion is possible.

In the Salt Range, Northwestern India, mammals and other Tertiary fossils were first laid down, then trilobites and related Cambrian fossils were deposited upon them. In many places in the Alps the Tertiary fossils were first deposited, then various kinds of Mesozoic. And so we might proceed all around the world.

All of which proves as conclusively as if we possessed written records of the facts, that in the world of long ago such animals as trilobites, and dinosaurs, and mammals, and in fact all the various kinds of life, lived contemporaneously in the same world.

Just at present we are not concerning ourselves with the problem of how these various kinds of animals became buried in the deposits where we now find them. We are concentrating attention on the one problem of the alleged historical sequence in which they lived; and we find this sequence or serial order is not a scientific fact.

There is no possibility of denying this conclusion, except by flouting all scientific or inductive methods, and allowing a metaphysical theory of how the fossils *ought* to be found to rule against the objective evidence whenever we find them occurring in any other sequence. This overruling of the objective evidence has now been followed for many years. But it is high time to discard such fantastic methods of reasoning, and to face all the facts fearlessly and without evolutionary prejudices.

When we take the facts at their face value, saying, as the evidence forces us to say, that all the various kinds of life found as fossils probably lived contemporaneously in the same world, some very interesting conclusions must follow.

These conclusions will appear later.

We must next consider the widely accepted theory of an ice-age.

## VIII

## SOME ICE-AGE NONSENSE

PROBABLY in no other department of human activity has so much good ink and paper been wasted at the taxpayer's expense, or so many gifted souls been kept milling around in futility, as in such geological discussions as those about the successive floras and faunas, continental glaciers and ice-sheets, and (more recently) floating continents. Tons of perfectly good printing materials have been produced or mulled over by thousands of people who were once capable of recognizing the difference between the true and the false in scientific methods, but who by reason of long years of false education have now come to the place where they accept, at least without outward protest, such burlesques on the scientific method as are involved in the theories of " deceptive conformity " and " thrust faults."

" But," some reader will say, " were there not big glaciers in the long ago, bigger ones and many more of them than we have today? "

Very likely. I can even adduce good scientific reasons for so believing. Let me set down some of the indirect evidence which would make such a condition probable, then some objective evidence which can best be interpreted in that way.

On the hypothesis of a great and sudden world-catastrophe, we know that it must have taken a considerable time, perhaps decades or centuries, for the ocean water to cool off to its present icy condition. In the previous age, with a semi-tropical climate prevailing throughout all the arctic regions, as was surely the case, all of the ocean water must have been warm. Even now, after all these millenniums, the mass of the water in the Mediterranean and other deep seas, which are shut off at their openings by barriers which will not allow the icy waters from the poles to creep into them at the bottom, is still very much warmer than the mass of the oceans at the same depth. These shut-off seas doubtless represent somewhat the condition of all the ocean water before and immediately after the Deluge. This original temperature could not have been much below seventy degrees Fahrenheit.

And as long as this original warmth remained in the ocean the warm water would have to float on top. Now warm water in contact with cold air must always produce mists and fogs and cloudy weather. These are the ideal conditions for producing heavy accumulations of ice and snow.

Again, as we look at our continents today, we see that from one-fifth to one-fourth of the land surface of the entire earth drains into interior basins with no outlet to the ocean. We might easily reason that after the Flood all these immense basins would be full of water to their very brims,—this would necessarily be the case. And as we examine these great interior basins today, we can see with our eyes the marks of the old shore-lines away up on the sides of the mountains which rim them around. Clearly enough when these basins were all full of water the climate of most of the world would be very much more humid than at present, with much greater precipitation throughout the entire year. For these interior basins are not confined to the horse-latitudes north and south of the tropical belt, where indeed many of them are found in regions now largely desert. They also occur in temperate latitudes, Great Salt Lake and the Caspian Sea being the partially dried-up remnants of two such former inland oceans.

So long as any of the original warmth of the ocean waters remained, and so long as most of the water remained in these huge interior basins, the climate of all the earth, especially of the northern hemisphere, must have been cool and damp far beyond any modern experience in these regions.

Even under our present-day conditions a relatively slight change in temperature or in the prevailing humidity would produce glaciers where they are not now known. If Montana were as humid as Switzerland, its few slim glaciers would become gigantic masses that would drive human life and industries far from where they now prevail. If the general temperature of Switzerland were to rise four degrees or five degrees Centigrade, the snow-line would be driven high up on the mountain peaks and all its present glaciers would disappear. On the other hand, if its general temperature should fall an equal number of degrees below its present annual average, the present glaciers would enormously enlarge and would extend down to valleys which are now full of towns and villages. And it is safe to say that the two factors spoken of above, the warm surface waters of the ocean and the interior basins full of water, might easily have produced an annual mean climate ten or fifteen degrees lower than the present, conditions which would probably cover Switzerland with one confluent mass of ice, and bring down immense glaciers in other mountainous regions where such phenomena have never been known in modern times, as in the British Isles and in the eastern parts of the United States.

One other important condition of affairs must be taken into consideration. If we still follow out the results consequent upon a great world-catastrophe, we have to suppose that almost all the mountains which now lift their bare bones to the skies were probably covered several hundreds or thousands of feet deep with stratified deposits, and that these strata were still soft and unconsolidated when the waters of the ocean subsided to their present levels. As the immense masses of snow and ice began to accumulate on these soft mountains, which would then be much higher than at present, gigantic avalanches would result, producing those wide-circling ramparts beyond the bases of all the northern mountains which are usually called the moraines of ancient glaciers. The somewhat similar encircling masses of heterogeneous materials around such bodies of inland water as the Great Lakes of North America, may be explained as the ice-ramparts or the old shores of former much larger lakes.

If now, after these bleak conditions with large accumulations of ice had prevailed for a century or so, some minor disturbance of the ocean bottom in the form of a series of big *tsunamis* (usually called tidal waves) should originate somewhere in the vicinity of Iceland or the North Atlantic, it would bring down upon Western Europe and the northeastern part of North America floating masses of ice which would go far to produce over the flat portions of those lands all those phenomena which are usually attributed to the " Glacial Age." Or, as the ocean seems to have begun its retreat from off the continents at about the beginning of the northern winter, we might even suppose that most of these " glacial phenomena " over the flat parts of Europe and America were produced during this retreat of the oceans, as was once considered a sufficient explanation under the name of the " northern drift."

Such, in brief outline, is the new method of accounting for those peculiar phenomena which for three-quarters of a century have given the world what Sir Henry H. Howorth has piquantly called a " glacial nightmare." The present explanation follows naturally and inevitably from the larger hypothesis of a great world-catastrophe, which seems to be the only alternative left, if as proved in the previous pages the fossils all lived contemporaneously in the same world. This modern " drift theory " invokes no extra-mundane forces, it involves nothing out of harmony with the known physical laws of ice and air and water, and it accounts for all the outstanding facts. All of which is much more than can be affirmed of the prevailing glacial theory.

The latter theory involves more incredibilities and impossibilities than can be listed here. But it may be worth while to look at a few of them.

One of the most elementary facts about the physical behaviour of ice is that pressure makes it melt. The mere weight of a sufficient mass of ice will cause the bottom to melt. It has been proved that ice cannot be piled up much more than about 1,600 feet deep without the weight causing the lower layers to melt away because of the mere pressure. This fact of itself alone dissipates the wild theory of a continental mass of ice a mile or more thick over much of North America and Europe.

Ice will flow under the force of gravity; but in such a case it flows by falling; and it ceases to flow when it ceases to fall. It can no more flow uphill than ordinary water can. Hence the myth of a great mass of ice flowing out from Labrador and Keewatin over to the Rocky Mountains or to Nebraska and Ohio, is shown to be without any foundation. Even the push from behind which would be required to propel such a mass across a flat country would be much more than the weight of the 1,600 feet mentioned above. Thus in every way in which we can examine this problem by the laws of physics we find that the theory of a vast ice-cap, flowing out from one or more centres in the north or east of the continent, is absurd and unscientific.

The greatest glaciers in our modern world are in the Antarctic. Recently some English men of science have made a study of conditions there, Professor Griffith Taylor, Captain Scott's senior geologist on his last expedition and now holding the chair of geography at the University of Chicago, being one of them. In their report they declare that "glaciers protect the underlying land," instead of wearing it away and digging out deep lakes, as the glacial theory has so long taught us. These modern men of field observation instead of armchair theories tell us further that the ice-mantle of the Antarctic, considered as a whole, "exercises a predominantly conservative influence" on the land surfaces underneath it, which is completely contrary to the visionary theories which we have been taught by the followers of Schimper and Agassiz. These modern investigators emphasize the "importance of sea-ice as a geological agent," and declare their belief, as a result of their observations in the

Antarctic, that "ice plus water is the effective agent" in producing those peculiar phenomena which have for so long a time been attributed to land ice alone.

From this brief study of a very vexed question we conclude that there were probably much larger glaciers among all the northern mountains during the years or the centuries immediately following the Flood. Some of the masses called moraines which occur around the bases of the mountains are to be attributed to avalanches and the former extensions of real mountain glaciers; some of them are probably the old strand-lines or shore-lines of the ancient ocean, as it was retreating from off the lands.

The theory of an "ice age" was invented as a sort of mental buffer, an intellectual shock-absorber, to make the transition from the fossil world to the modern seem less abrupt and less catastrophic in nature. For a hundred years it has covered up the real facts of abruptness and strangeness in the change from the antediluvian world to the modern. The fable of an "ice age" was a clever addition to the other fable of a long series of successive ages. But with the pitiless exposure of the general theory of successive ages which modern discoveries are now producing, we see the collapse also of the myth of great ice-caps a mile or more in depth which it has been supposed once covered most of Europe and North America.

When we get a correct view of the general problem of geology, we cease to be troubled with a "glacial nightmare."

# IX

# SOME OBJECTIONS ANSWERED

I AM not here concerned with objections to my criticism of the alleged chronological order of the fossils. My previous larger treatise on this subject has not been answered. It will not be answered. But it has been ignored, and probably will still be ignored, because very few even among men of science have the patience to follow carefully a completely new line of argument based on unfamiliar facts.

The objections which are urged against my theory of a great world-catastrophe may be classed under two heads, the religious and the scientific. It may be best to reply to some of these here; and it will probably be better to take the religious objections first, so as to have them disposed of when considering the strictly scientific ones.

1. *A world-catastrophe, such as you have postulated, would involve a real miracle; perhaps a series of miracles; and it is not scientific to invoke a miracle to explain a difficulty in natural science.*

I suppose that something very much like a miracle is involved in the events alluded to in the preceding pages as an explanation of how the ancient world was transformed into the present one. But what is meant by a "miracle"? As a believer in the living God, Who is still in charge of His universe (not an absentee God) and Who presumably can do as He sees fit with anything or everything in it, I do not take any great interest in the distinctions which some people try to make between natural laws and miracles. I suppose that any event which has happened but once in the history of mankind might well be termed a miracle; while any event which has occurred several times, even the resurrection of dead persons, might be termed natural law. I am not disturbed by this objection. For plenty of phenomena familiar to natural science are still wholly inexplicable without a constant miracle, in the sense that we cannot assign a material " cause " for them, and must attribute them to the direct act of the God of the universe. Gravitation is one of these phenomena; but there are plenty of others. We live in a world of constant " miracles; " and instead of diminishing in number they seem to be increasing with the progress of our knowledge of science. One more " miracle " added to the list should not disturb us in our scientific thinking.

2. *You'll never get scientific people, or educated people of any class, to believe that the world is only some six or seven thousand years old.*

Perhaps not. Though I fancy that what is meant by this objection is that if any person should be caught admitting such a foolish notion, he would thereby prove that he is not " scientific " nor indeed " educated " in any proper sense of these terms. There are probably more intellectual snobs in the world today than ever before. But I happen to know a few people who believe that such ideas as the age of the world ought to be a matter to be decided by the *evidence* available, and not be held to unthinkingly because they themselves may have absorbed certain prejudices on this subject by the untiring propaganda along this line which has been kept up for two generations.

After all, why should we not try to shake off some of the influences of mob psychology and do some independent thinking for ourselves? The standardized thinking which has been drilled into the people of America and Europe for a hundred years or more is greatly opposed to any view of the age of our world which does not deal liberally in astronomical figures. But again I say that any idea which we may have on this subject ought to be strictly governed by the evidence the one way or the other. In the preceding pages I have tried to give some of the evidence for the shorter view. I must ask the reader to judge the case by the evidence there presented.

3. *We own that the seeds of plants and possibly the eggs of fishes and of the invertebrate animals might possibly survive such a world-convulsion as you invoke; but how could any of the land animals escape destruction? How could a big wooden boat, with eight people in it and a lot of animals, ever come through a year or more of such turmoil safe and sound?*

From the scientific point of view I can only say that, while many animals perished entirely, so as to leave no survivors, a large number seem to have survived somehow; for their descendants are still with us in the modern world. Scientifically there is no other answer. What does *science* know about any of these things? From the point of view of the Bible record, it is easy to say that God attended to this matter of caring for those types of animals which He wished to survive, so as not to destroy the life of the globe entirely. I know no other answer.

4. *If man was contemporary with the trilobites and*

*the dinosaurs, why don't we find some human skeletons among these fossils?*

Although this sounds like a scientific objection, it can be answered either scientifically or theologically. The scientific answer would be that probably man did not live in the same localities as the trilobites and the dinosaurs and the other fossils which we have discovered. It is not a common thing to find plants and animals of any sort together in the same bed; are we to conclude from this that the plants were not usually contemporary with any animals? We have no reason to suppose that the earth was inhabited all over before the Flood. Perhaps some day we may find some relics of those antediluvian people, and then we shall know more about it all. The theological answer would be that, since we are told that the Lord wished to destroy that ungodly race, He probably did a good job of it and buried them so deeply that we have not yet discovered their remains. We have no idea whatever as to what part of the globe was inhabited before the Flood. It may have been the part now at the bottom of the Pacific, or at the North Pole, as many have said. The common notion that the original home of mankind was near the Tigro-Euphrates Valley has nothing to sustain it. True, a number of names occur there which correspond to the place-names mentioned in Genesis concerning the world before the Flood. But there are also many place-names in New England which correspond to names of places in Old England; and the reasons for these similarities are the same in both instances. If the survivors from the Flood landed somewhere in the mountains of Armenia, that would make this region the focal point of distribution for both man and the land animals over the new face of the earth; and this would agree with all the facts that we know about the early distribution of mankind. The distribution of the animals would offer some perplexing problems, though I do not think that they are beyond solution.

The remaining objections which are usually made against this hypothesis of a world-catastrophe are scientific in character, and will be considered accordingly.

5. *Where did all the water come from sufficient to cover all the continents?*

About seven-tenths of the surface of the globe is now covered by water, the oceans averaging about 13,000 feet in depth. The average height of the lands is about 2,300 feet above sea level. Thus the ocean averages about 5.6 times as deep as the land is high; and as there is about 2.8 times as much ocean surface as land surface, it follows that there is about 15.6 times as much water below sea level as there is of dry land above it. From this it is easy to calculate that if all the continents were to sink below the sea, the water surface would be raised only a few hundred feet, or only a few times as high as the tide now rises in the Bay of Fundy. In addition to all this, it has been calculated by some of our best scientific men that if all the inequalities of the globe were smoothed out, so that the solid part would have a uniform surface, the waters would cover the entire globe to a depth of about 9,000 feet, or about a mile and a half.

Manifestly there is no lack of water. And if any astronomical disturbance were to arise which would give the earth a slight jar from the outside, immense tidal waves would sweep around the globe, their height and devastating power being proportioned to the magnitude of the jar thus received. Many geological phenomena, particularly the almost constant alternation of beds in all parts of the globe, seem to point to some great tidal disturbance as the origin of these stratified deposits.

6. *It is quite absurd to think that there could be enough vegetation growing at any one time on the globe to produce all the coal deposits.*

Perhaps not so absurd, after all. We must remember that the ancient world had a most wonderful climate; for mild, semi-tropical conditions prevailed throughout the entire Arctic regions. We have not found any fossils of any desert species of plants; hence it is fair to infer that there were no deserts before the Flood. A marvellous climate, an entire absence of desert wastes, and a luxuriant growth of vegetation all over the lands, with no wild barren mountains, but with every part of the dry land abundantly covered,—all this would be in accord with the kind of world which the Lord had made and had pronounced " very good."

Under these conditions, with an abundance of moisture to prevent any devastating forest fires, and apparently with very much less active bacterial action, the accumulations of sixteen centuries, together with the vegetation growing at the time of the Flood, might easily suffice to produce enough materials to make all the coal beds of the entire world, even if we do not suppose that the land surface of the antediluvian world was much larger in proportion than at present, though the latter supposition is believed by many.

7. *Why do we find the various kinds of plants and the various kinds of animals all so segregated off by themselves, as we seem to find them in the strata?*

It is possible that, in the earth as the Lord first made it, the floras and faunas would be much more sharply defined than at present. An artistic gardener plants his various flowers largely in beds by themselves. But it is also possible that our geological classifications have given us an exaggerated idea of the separateness of the various kinds of life. Fossil animals and fossil plants are seldom found together anywhere in the strata; are we to conclude from this that the animals and the plants did not live together in the same world contemporaneously? Plants and animals still live in habitats more or less segregated from one another; and it is these floras and faunas of the ancient world which we now find buried in the strata and which we call the geological " formations." It has often been said that the fossils of one formation are never found mixed with those of others; but this is not true. It is on a par with that old fable which all the old geologies used to repeat parrot-like, that all the fossil plants and animals belong to " extinct species."

In reality, most strata contain many fossils which depart more or less widely from the " typical " assemblage supposed to characterize the particular formations to which they are assigned. How often has it happened that a set of beds has been classed as belonging to a certain series or system, and later under the strong protests of experts it has had to be changed over to some entirely different series or system. The United States Geological Survey maintains a standing committee to settle disputes of this character; yet in spite of this there are still many sets of rocks which are disputed in spite of all the discussions. All of which tends to show that the sharply defined differences between the various rocks as found in the field are much like the reports which Mark Twain said he had heard regarding his own death, they have been greatly exaggerated.

8. *How could so much unconsolidated materials have been on hand, so as to make all the immensely thick beds which we find now covering nearly all the lands?*

The consolidating or hardening of soft clays and sands into shales and sandstones is a chemical process, quite similar to the " setting " of cement. The Cambrian blue clay and sand which occurs in many districts around the Baltic, is said by geologists to be a thousand millions of years old; yet it is as soft as if deposited last year. Other deposits which contain human remains and which (even by the evolutionists) must be called very " young," are as solid and hard as some of the most ancient rocks.

Nobody knows exactly why some of these deposits are still soft and others hard; but it is not incredible that before the Flood very little of that mixing of materials had taken place among the sands and clays which seems to be essential for the setting or hardening of them into the masses with which we are familiar.

9. *How could all the strata have been laid down instantaneously, as your theory requires?*

There is nothing instantaneous about laying down deposits a mile or so in thickness during twelve months or more of time. Plenty of examples are known in modern times, as well as unmistakable evidences from the ancient deposits, of one fling of a wave or current resulting in the deposition of a cubic yard of soft materials, such as sand or gravel. No such rate of deposition would be necessary in order to

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lay down beds a mile in thickness in much less than a year.

10. *The current system of geology has amply justified itself by its wonderful achievements in locating coal, oil, gas, and the various minerals.*

Yes; it has proved its ability to locate these deposits. But what do these discoveries (accomplished by purely *empirical* methods) have to do with justifying those *theoretical* ideas with which we have been dealing? The two have nothing at all in common, and have no dependence whatever upon one another.

On the other hand, it is a well-known fact that theoretical prejudices about there never being any coal or oil except in association with certain fossils, have often in the past resulted in hindering discoveries almost under the noses of the explorers. When it was believed that there was only one " coal age," men did not expect to find good coal except in connection with Carboniferous beds; whereas we now know that plenty of good coal beds are found in all the other systems. In the same way it used to be thought that petroleum could never be found except in the presence of certain of the Palæozoic rocks,—an idea which for many years blinded the eyes of explorers to some of the richest oil deposits.

11. *This theory of a world-catastrophe was discarded a hundred years ago for sufficient reasons, and cannot be revived again today.*

The theory of " Catastrophism," as held a hundred years ago, had no resemblance to the theory here discussed, except in the name. A long series of successive catastrophes was taught by Baron Cuvier and others; but this theory was the very one which fastened on the world that system of exact chronological distinctions between the fossils which we are now with such difficulty outgrowing. Hence Cuvier's Catastrophism differed *toto coelo* from the view here propounded. Cuvier's theory laid the entire structural foundation for the theory of organic evolution; the present theory of one great world-catastrophe is the only effective answer to the theory of organic evolution ever made or ever possible. John Woodward (1665–1722), in a very notable work issued in 1795, taught substantially the same view as I have here suggested. But Woodward did not have at that time any such collection of facts for framing an intelligent hypothesis as we have at the present day.

12. *To explain the work recorded in the rocks must always be a case of energy versus time; and it is much more scientific to appeal to limitless time than to limitless force.*

Why? The real scientific method would be to decide between energy and time strictly according to the evidence. Energy and time are often not at all commensurable. The kind or quality of the work done must always give us grounds for deciding intelligently between energy and time. As Howorth expresses it, no amount of time will enable a set of human teeth to drill holes in a steel plate. The common method of appealing to an unlimited amount of time to solve the problems of geology is usually nothing but an attempt to dodge the issue, to push the entire problem back so far into the shadow that we cannot discern its conditions at all clearly. An appeal to time is usually an evasion, not a solution of the problem. In all cases, however, the appeal to the one or the other ought to be strictly a matter of the evidence.

13. *The theory of organic evolution can now be proved in many ways quite independent of the evidence of geology; then by turning the case around, we can prove the many geological ages by our knowledge of organic evolution.*

This is the latest line of defence; but it is surely a most curious method of reasoning. What would such men as Cuvier, or Lyell, or even Darwin himself have thought of this method of making the tail wag the dog?

Any theory of organic evolution worth considering must have as a background, or as an outline, independent historical evidence of successive floras and faunas in a definite order of progress during long periods of time. This background or outline has hitherto been furnished by geology, as commonly supposed. Without this background or outline, we might indeed have some theory of changes among the various types of plants and animals, as suggested by our studies in heredity and genetics. But how could any such theory of organic change by itself furnish any solid reasons for arranging the fossils in an alleged chronological sequence?

Such an idea is grotesque in its lack of logic. Modern biology has a hard enough time as it is to support its theory of transformism or evolution, without being asked also to construct its own historical outline.

14. *Geologists don't depend entirely upon the fossils in telling the " age " of a set of rocks.*

Let us see. Geologists use the ordinary rules of common sense in telling the relative relationships of any two adjacent beds, so long as typical or " index " fossils are not available. But fossil evidence is always held to be superior over every other kind of evidence whatsoever, as is illustrated by the many examples of " deceptive conformities " and " thrust faults." Every physical evidence is overridden and completely disregarded, whenever these physical evidences are at variance with what is regarded as the fossil evidence.

The truth on this point is so vital to the present discussion, that I shall crave the reader's indulgence to introduce the formal testimony of two experts. The first witness will be Professor A. W. Grabau, formerly of Columbia University, and now chief palæontologist of the Geological Survey of China. I quote from his massive and scholarly *Principles of Stratigraphy.*

> " The primary divisions of the geologic time-scale are, as we have seen, based on the changes of life, with the result that fossils alone determine whether a formation belongs to one or the other of these great divisions." (*Principles of Stratigraphy,* p. 1103.)

This testimony is unequivocal concerning the great divisions of the " time-scale," the Palæozoic, the Mesozoic, and the Cenozoic. But the very same principle is applied in assigning a set of beds to one of the next divisions, the *systems,* and so on all down the line to the more minute subdivisions.

The second witness is Professor Henry Shaler Williams, at one time Professor of Geology in Yale, but whose brilliant career was cut short by an early death. What I shall quote is from a book whose chapters were first delivered as a series of lectures at Cornell University.

> " These systems [Tertiary, Cretaceous, Jurassic, etc.], although actually arbitrary groupings of the

> stratified rocks of particular regions, have come into common use as the primary divisions of the rocks whenever chronological sequence is considered. In describing any newly discovered fossiliferous strata in any part of the earth, the first step to be taken, in giving them a scientific definition, is to assign them to one or other of these systems upon evidence of the fossils found in them. The character of the rocks themselves, their composition, or their mineral contents have nothing to do with settling the question as to the particular system to which the new rocks belong. The fossils alone are the means of correlation." (*Geological Biology*, pp. 37, 38; 1895.)

Accordingly, I am now compelled to say that the statement made in the objection which we are here considering is not true. But such a statement is often made by men who are unacquainted with the fundamental principles of the science, who may be familiar with the working methods in the field, but who have not thought deeply or read widely in the literature of the science. Unfortunately there are among the students and teachers of geology an unusual number of men who may be expert in field methods, but who are such narrow specialists that they are often grotesquely unable to see the deeper aspects of geological problems.

15. *On the theory of a great world-catastrophe, how do you explain the presence in Australia of all the chief marsupials (except the opossums), and in South America of all the chief edentates?*

I confess that the distribution of the great groups of animals is a very difficult problem. But I do not think that it is more of a problem for me than for the evolutionist. The latter has to say that the mammals, in all probability, spread out from some centre in Western Asia. On the theory of a universal Deluge, according to the record in Genesis, this same place became the distributing point from which all the surviving animals must have scattered out over the face of the recently desolated earth. But on my view, these animals were under the direct guidance of the Creator, Whose care is still marvellously shown in the migration instincts of such animals as the storks, the swallows, the golden pheasants, the Arctic terns, and the eels. On the basis of the evolutionary theory, what is there except blind chance to superintend the distribution from the common centre which we know actually occurred?

There are complications and difficulties, I admit. But I do not consider these difficulties entirely hopeless of explanation, even on a purely scientific basis. On the other hand, it is self-evident that such difficulties about the distribution of the animals can never become a major objection against the view of a world-catastrophe. Least of all can such difficulties be used to justify the grotesque want of logic in the idea of the successive "ages," which is the chief point under discussion in this book.

# X

# CONCLUSIONS

IT seems most unfortunate that, a hundred years ago, the governments of the civilized world set official sanction to the crude geology of that day by establishing geological surveys. At first it seemed a splendid recognition of natural science by organizations with enough money to back up any line of investigation. It proved a great success in one way; for the various governments have undoubtedly received in financial returns many times the amounts they have expended in their surveys. And many splendid men have been enabled to carry on important scientific researches who, if they had not been backed by their governments, would have had to toil on in poverty and obscurity and could never have accomplished their tasks.

The worst effect was upon the rising science of geology itself. At that time geology was just beginning to master the technique of classifying the stratified rocks according to the fossils they contain. This idea has proved so handy and convenient as a tool of classification that it has long since become the universal method, completely displacing the preceding method taught by Werner. But apparently very few of the many thousands who have employed this method have ever questioned the basic logic of employing these fossil sets as representing a real chronology for the world as a whole, nor have they realized that they were employing an onion-coat theory of the fossils instead of an onion-coat theory of the minerals. That the new method worked so well as a tool of classification was sufficient. Why bother about questions of logic or inductive methods, when some ingenious way could always be found of solving any classification puzzle by the very elastic and accommodating method of giving the rocks a ticket based on the kinds of fossils they happened to contain?

Strange as it may seem, the very success of this method of classifying the strata proved the worst thing possible for the young science of geology; for it brought on a severe case of arrested mental development. It resulted in a hard, intolerant "orthodoxy" among not only the survey officials of the various governments, but this spirit of a well-subsidized orthodoxy spread its influence to control also all the teachers of the youthful science in all the big universities. The Protestant churches of England and America hastened to make the geological "ages" an integral part of their system of apologetics. The spectacular success of geologists in locating coal, oil, and minerals insured the friendship of the commercial interests; while the finding of immense prehistoric skeletons here and there all over the world secured the reverent homage of the multitude for every fairy tale which was published in the name of geological science. Thus its very success made its leaders quite immune to criticism on the score of logic or scientific methods. And yet nothing is more fatal for the development of a science than for it to crystallize into a rigid orthodoxy, and the earlier in its history it develops this condition, the worse it is for the science as an unbiased and fearless method of stating the real facts of the natural world.

It is true that a few of the crude ideas with which geology set out have been shaken off. The dogmatism that all the fossils of at least all the " older " rocks belong to " extinct " species, the alleged fact that no fossil found prominently in one " age " ever survives into another, the quite natural idea that all the " old " formations ought to *appear* old both by stratigraphic position and by texture, and conversely that all " young " formations ought similarly to show their youngness by the opposite characteristics,—all these ideas have long since been scrapped as rules for identifying the rocks. Into the same scientific wastepaper basket have gone the early ideas that good coal beds belong only to the Carboniferous, that oil is never to be found in any except certain horizons of the Palæozoic, with many other early empirical rules. The one basic rule which has never been seriously questioned, and which has long since become an iron despotism over the minds of all geologists the world around, is that the various sets of fossils actually represent successive floras and faunas which have peopled the world one after another, thus telling us a true history of the life on the globe. A few of the many objective discoveries in the field plainly contradicting this theory have been enumerated in the preceding pages. But up to the present they have never been allowed to influence in the slightest degree that smug dogmatism about the scientific value of " index fossils " which is still taught for science in all the colleges and universities of the world.

This geological orthodoxy is insured by the overspecialization which has overtaken this science as well as all the others. Such specialists are engaged only in the accumulation of new facts, with which to add to the mass of data already grown to such proportions that they cannot be mentally assimilated. A much rarer kind of specialist, but one quite as essential for the progress of human thought and one imperatively needed at the present stage of human knowledge, is the man who devotes himself to mastering the logical and philosophical aspects of some big scientific problem. For the mere accumulation of facts can never make a real science; intelligent criticism is as necessary for progress as is the gathering of fresh data. And the man who familiarizes himself with all the known facts along a certain line, who acquaints himself with all that others have done or written on this subject, and who devotes the best years of his life to the critical study of all the logical relations between the various aspects of this problem and all other problems within its vicinity, may well be regarded as a specialist in these matters. And specialists in logic and scientific method are as essential to progress as are the various specialists engaged in accumulating new facts.

But the criticism of popular superstitions even in natural science is usually a thankless job. The story is told of some fowls in a farmyard which were discussing their individual problems, when one hen said to her neighbour, " The master says he doesn't like your eggs; for your eggs are not always good." The other hen replied, " Tut, tut, how does he know a good egg from a bad one? He never laid one."

Similarly I am acquainted with some field geologists, very estimable men personally, who have nothing but contempt for any one who presumes to criticize the logic of such a theory as that of the successive "ages," because the critic has not made any notable discoveries in the field. Yet it ought to be obvious that one does not have to spend his life in pounding out specimens from all the formations in the Alps, the Rockies, and elsewhere, in order to be able to judge of the logic of a scientific statement. Why should it be considered necessary for one to become an expert in laying eggs, before he is permitted to express an opinion about an individual specimen as to whether it is good or bad? It has usually been the case that those most accustomed to field work are not equally accustomed to logic or scientific method. In my humble opinion it would be a good deal better for the future reputation of certain field experts to spend a little less time in collecting and a little more time in quietly thinking through some of the basic ideas of the science in the light of logic and enlightened common sense. If even a few of our leading geologists and palæontologists would now undertake to think out the real meaning of the vast mass of data which have already been accumulated, geology might before long graduate out of the empirical and speculative stage and become a real science.

Yet there is always a danger that the critic or the specialist in logic, as I have called him, may forget that others may not instantly perceive the logical consequences of a certain set of facts with which he himself may long have been familiar, and that he may blame others for their perverseness or stupidity in not seeing these logical conclusions as clearly as he does himself.

I wish to avoid such a tendency of intolerance toward my readers. I hope I realize the warping effect on the mind itself of false ideas which have long been held familiarly. For misinformation and wrong methods of mental training are far greater handicaps to clear and logical thinking than is mere ignorance. In all our dealings with any large problem, especially in trying to see its real relationships to other large problems, it is most emphatically true that it is far better not to know so much than to know so many things that are not true.

In the preceding pages I have presented certain facts and have drawn certain conclusions. If I have seemed emphatic in stating my conclusions, and if at times these conclusions may have seemed to the reader somewhat extreme or even entirely wrong, I hope that my readers will remember that I am merely trying to state these things as they seem to me after some thirty years of study of these problems.

In this closing chapter it may be worth while to repeat some things stated in the previous pages. Two classes of conclusions may legitimately be drawn from the facts of geology as we now know them, the one set being the purely scientific, the other set partaking of the nature of philosophy and religion. All truth is a unity; and to me all such subdivisions are but different aspects of truth in general. Our divisions between what we are pleased to term scientific problems and religious problems are artificial and unnatural. But for the convenience of those of my readers who do not look at these matters as I may do, I shall try to separate the strictly scientific conclusions from the philosophic and religious. For the first set of conclusions I must claim all the force of strict logic and scientific demonstration; for the latter I shall merely claim my own personal convictions, giving every other person the right to differ with me as he may see fit.

We have learned that rocks are classed into one of the geological " ages " or another entirely according to the kinds of fossils they contain. Physical appearance has nothing to do with the place to which they are assigned in the geological " time-table;" for beds which contain very " young " fossils may look astonishingly old; others containing " old " fossils may look very young, and may even be soft and unconsolidated, though they are allegedly hundreds of millions of years old.

The oldest fossils ought always to be found at the bottom of the stratified beds, and no other kinds of fossils should ever be found at the bottom. But both these rules are contradicted by what we actually find in the field. There really is no such condition as any particular set of fossils being at the bottom of the series; for any sort of formation (containing any kinds of fossils) may be found in this position next to the granite or Primitive rocks somewhere. There are no bottom fossils for the world as a whole. Thus there is no place at which we can find fossils which we can prove to be really older than others elsewhere.

In the next place, very " young " beds often occur in absolute *conformity* upon others declared (because of their fossils) to be many millions of years older, all this vast interval being absolutely unrepresented either by deposition or erosion. According to plain common sense, these beds must have followed one another in quick succession. Such examples prove conclusively that the great " ages " said to have intervened never did exist in these localities; and hence the conclusion is inevitable that these alleged " ages " never existed anywhere else, but that the kinds of fossils which are supposed to represent these "ages" were merely local faunas and floras which might or might not be buried in one locality or another.

Numerous kinds of fossils, often whole tribes or classes, skip many of the alleged "ages," with no regard whatever to the necessary continuity of life all down the formations.

Finally, very "old" beds often occur in perfectly good conformity upon beds classed as very much "younger," there being every physical appearance that these beds were actually deposited in this relative order. In other words, the "ages" are often found reversed, with every physical evidence that this reversed order is just as natural as any other.

From all these facts the conclusion is inevitable that the fossils do not occur in any definite order, as has been alleged; hence it is nonsense to attach any time-value to any particular fossil or set of fossils. Instead of being found in a historical sequence, all the various fossils must have been living together contemporaneously in the same world. One can make any of the strata as old as one wishes (and I use the word "wishes" advisedly); he may project all these forms of life back into the past a million years or a hundred million. But in the light of the set of facts enumerated above, he cannot put one kind of fossil back any further than another. He must say that the fossil world is a unit, so far as its life is concerned. The fossils represent one age, not a series of successive ages; and there is no possible method of proving one kind of fossil older than another for the world as a whole.

Let us consider these facts again in some detail.

The trilobites, for instance, are always considered splendid " index fossils," and are always indicative of some of the Palæozoic formations. But throughout a wide region in Alberta and Montana, dinosaurs and plenty of very modern looking vegetation were laid down *before* the trilobites. In the Salt Range, India, mammals and other Tertiary animals and plants were deposited *before* the trilobites and graptolites in that locality. Now, unless we are bold enough to say that the rocks are lying to us, we must admit that mammals and dinosaurs and trilobites all lived in the same age of the world, that is, they lived contemporaneously.

The man who still persists in saying that he knows better than this, that these animals were never contemporaneous but lived only in distinctly different ages many millions of years apart, will have to convince us that he has some outside source of good scientific information on this point entirely apart from the record of these rocks. He will hardly claim any supernatural knowledge of the past. The only argument that I have ever heard to support such a claim is that, as a general rule, we *usually* find the fossils in a certain relative sequence. But what a childish argument.

*"Ah, what avails the classic bent,*
*And what the cultured word,*
*Against the undoctored incident*
*That actually occurred?"*

An English author, dealing with the scientific method, says: "Any attempt to make facts square with a pet hypothesis is a sure and certain mark of the unscientific mind." This being so, there is nothing left us but to accept these facts as they really are.

When we consider the stratified rocks of the world as a whole, we find them (that is, their fossils) in such diverse and varied relationships of superposition (and therefore of deposition) that we are compelled to believe that they all lived contemporaneously together.

From these facts we get a true geological age, an age very decidedly different from our own; but *we can never get any series of successive ages.* The latter idea is just another mistake made by hasty generalizations long ago, just another added to the long list of scientific blunders.

But why do I attempt to brand it as a " hoax," instead of leaving it merely as a mistake, a blunder?

Because geologists (and their many imitators) still persist in teaching this blunder to confiding pupils and to an equally confiding public, in the face of the clear exposure of this blunder which has now been before the scientific world for over a quarter of a century. It would be ill-mannerly on my part, perhaps uncharitable, to say that the continued teaching of this discredited theory as a fact, is a fraud. The most charitable view to take is that it is just a big joke, a colossal game of bluff, and therefore a real hoax on the public. For the adherents of this theory evidently intend to persist in teaching it just as long as possible. And they also intend to ignore this and all other arguments against their theory just as long as possible. Let us see who will win out. The mills of the logic of science have a fashion of grinding very slowly, but they grind exceedingly small.

I have no objection to any one's making any single one of these fossiliferous beds just as old as he likes. He may picture how very, very slowly limestones are being formed at the present time. He may grow eloquent on the long millenniums required for the growth of the forests with which to make our coal beds. He may expatiate on the immense length of time required for so many thrifty-looking species to become worn out and gradually exterminated by the slow grind of time. In this way he may get a very long geological age, if his scientific conscience permits him to take a narrow view of the fossil world, and if he refuses to believe in the possibility of a great world-catastrophe.

But it remains as clear as sunlight that *not even such a person and in such a manner can get any series of geological ages,* except by arbitrarily announcing that he knows which fossils lived first, which next, and which still later, until we have a series of several hundred or several thousand terms. I confess that he has historical precedents among geologists for announcing such results of a supernatural knowledge of the past. But such would be a reversion to the methods of Burnet and Whiston, of Buffon and Lamarck; it has no kinship with the sound science of Kepler, Newton, Faraday, and Kelvin.

But what remains? Why, the entire fossil world remains. We may safely try to interpret the fossil record, if we do it by the sound method outlined in the first chapter of this volume, namely, by starting with the world that we really know, the present world in all its various aspects, and working backwards into the past, stopping of course when we reach the limits of secure facts.

This means that we must begin with the present living species of plants and animals, the present behaviour of our oceans and rivers, our atmosphere and our climates, projecting these conditions back into the past as far as we can go, and making them the key to interpret everything even back of that. It will mean that we must start with the surface rocks, the deltas, the river terraces, the old strand-lines, and see if possible what it was that changed that ancient world into our modern one.

To do such a task properly will require the best that a large army of patient observers and researchers can accomplish. It will mean the reorganization of much of our knowledge, the reshaping of our methods, the reorientation of our point of view. Such a work is too big for one already past the meridian of life, one who has spent a lifetime in trying to discover the new way. From Pisgah's top he may catch a glimpse of the promised land of undogmatic geology, of a geology stripped of all speculation and as securely laid on facts alone as are our modern physics and chemistry. But the task of leading the hosts of modern science into that land must rest with others.

Up to this point is what I regard as absolutely certain facts. From this point I wish to proceed one step further into what I personally regard as also secure facts, though some of my readers will say that I am now introducing considerable of the personal element, thus rendering doubtful some at least of my conclusions. Be it so. But only in this way can we make further progress.

Certain broad facts about our modern world seem to me to warrant the conclusion that the present order of things will never suffice to explain the geological changes which we find recorded in the rocks

Contrary to the opinion of Lyell, we now know that there are no currents at the bottom of the oceans, nothing to make any true stratified deposits there. All the deeper parts of the oceans—which means probably ninety-nine percent of their area—are absolutely calm and quiet. Yet here is where live the brachiopods, the crinoids, the siliceous sponges, and the many other kinds of invertebrates which contribute so largely to the making of the fossiliferous rocks. In the latter we find these animals systematically interbedded with sands and other detritus from the lands, even with land plants and animals. How can we explain such interbedding in terms of anything now going on in our modern world?

Lyell also thought that at the present time the coasts of all the lands are see-sawing up and down; and by means of this pulsation of the crust he tried to explain the exchange of dry land and ocean in the long ago. But our modern knowledge of the stability of our coasts will not permit us to use this as an explanation of the past changes. For the researches of such men as the late Eduard Suess and Professor Douglas Johnson, of Columbia University, have shown that no measurable changes of level along our coasts are now taking place.

Accordingly, if we project our present conditions backward into the past, we find that uniformity is bankrupt, so far as explaining the stratified deposits is concerned. There is no reliable explanation of extensive changes of climate, least of all of any such sudden changes of climate as we find recorded by the Siberian and Arctic elephants in cold storage. And to make the matter altogether hopeless of explanation, we have the fact now brought out in the previous pages that all the fossil kinds of animals and plants must have been living together in the same world,—

at least we have failed to make any reliable distinctions among them regarding the age in which they lived.

In view of all this series of facts, who would be so foolhardy as to try to defend geological uniformity? And who will stand up to deny that there must have been some tremendous earth-change in the long ago, this change being of the nature of changes of land and water, resulting in destroying and burying great multitudes of plants and animals?

All this I personally consider absolutely certain science.

How this great earth-change took place, the methods by which the oceans were made to overflow the lands, and all the rest of the details, are matters for speculation. I don't claim to know, I can only guess, like any one else. Let no one say that I have any cut-and-dried theory about any or all of these details, for I have not. I have some theories;—who that thinks does not have theories on all sorts of questions? But I try to keep my facts separate from my theories. And if my readers will always do the same, we can get along together famously.

But before closing this chapter there are some philosophic and religious conclusions which I wish to set down. Not all of my readers are going to agree with me in these conclusions; but I hope that no one will so violently disagree that he will throw this book down,—and turn out the light and go to bed. For the sake of such of my readers who are likely to balk at this point, I will say that what I am about to set down is merely my personal or private opinions, which no one need consider himself under the slightest (logical) obligation to accept.

Let us first look at some phases of the history of these problems.

Charles Lyell began his geological career about a hundred years ago, and he took over bodily and without criticism the series of successive ages which was even then held as an undoubted fact. Only, instead of many successive catastrophes, Lyell undertook to solve all the processes of the formation of the fossils in terms of the modern ordinary action of the elements, as known in the world today. He took over also from his predecessors some very evil prejudices about " extinct " species; but we need not go into this phase of the subject. Lyell's theory became known as the theory of Uniformity or Uniformitarianism.

Charles Darwin was a great admirer of Lyell, and extended the theory of Uniformity, or of modern natural causes, so as to include the origin of new kinds of plants and animals. So that, instead of having all the species of one geological " age " killed off in some mysterious manner and other species come into existence to take their places in a similarly mysterious manner, Darwin taught that natural laws now operating are quite sufficient to explain how this replacement of one set of animals and plants by another set was done. In other words, Darwin undertook to give a naturalistic explanation of the origin of kinds of organisms, just as Lyell had tried to give a naturalistic explanation of the geological shifting of land and water in the long ago. Together they gave us the theory of organic evolution as we now have it.

It makes little difference with the logic of the case, whether or not we believe that Darwin was mistaken as to the *particular method* by which his theory of transformism was accomplished. Most modern scientists agree that Darwin was probably wrong in his method. But they all stick to the general theory of organic development *somehow;* and thousands of the keenest minds among our biologists and geologists are still on the stretch, each of them hoping that he at last will hit on the right method by which organic development was accomplished.

And as long as they continue to believe in the accuracy of the geological " time-table," one can scarcely blame them for declaring that some form of organic evolution is much more reasonable than the old theory of successive creations and destructions, which would then be the only alternative.

Today the Fundamentalist who accepts all these successive sets of animals and plants in a progressive series, and who still stands out against the theory of evolution somehow, proves that he has never thought this matter through to the end. He is simply repeating parrot-like some things which he learned in college perhaps two generations ago, when these successive creations and catastrophes were commonly taught, and when good, sincerely Christian men like Dana, Hugh Miller, Hitchcock, Gladstone, George Frederick Wright, and many others tried to " harmonize " these successive geological " ages " with the days of Creation, as mentioned in the first chapter of the Bible.

The history of the past fifty years or so is abundantly proving that all this was a big mistake. The Christian Church has lost out in every single instance where she has tried to keep up this line of argument. A conspicuous example of this utter failure was the piteous figure which poor W. J. Bryan made in the hands of a skilful evolutionist like Darrow. If the tables had been completely turned, if Darrow had been put on the witness stand, and if some one who understood geology had asked him to prove the scientific reality of his successive " ages," the results might not have contributed so much to the gaiety of the nations, but they would have done vastly more for the enlightenment of mankind in this work-a-day world of realities. Bryan and his supporters did not realize that they had already travelled far on the road toward organic evolution by admitting these unproved and unprovable geological " ages," and that they must always make themselves ridiculous by trying to stop at the mere origin of species. Such tactics must always end in defeat and humiliation. The present crestfallen attitude of the Evangelical Church is almost entirely due to the fact that for over half a century this day-ages theory has been the only " recognized " apologetics of the Christian Church.

But the progress of modern science is also proving that, if the Church takes her stand by demanding good solid *proofs* for these alleged " ages " of geology, these proofs never are forthcoming. What, then, is there left for her to do, but to say that all these diverse forms of life may have (indeed must have) lived contemporaneously in the same age of the world's history, and therefore they must have been destroyed at substantially one time by what the Bible calls the Flood or the Deluge? When any Christian takes this position, intelligently informing himself regarding the pertinent facts as now known, he finds himself in a position where he has a safe and secure line of argument. And from this position he can never be driven by any fact or set of facts known to the modern world, except, of course, the classic cavil that miracles are impossible.

But perhaps it is too much for me to expect that all of my readers will henceforth have no further confidence in these long-popular geological "ages," and will with me say that the one great world-catastrophe, as taught in the Bible and now confirmed by modern science, seems sufficient to account for all the outstanding facts of the rocks. My experience teaches me that there are always many intellectual descendants of the Bourbons, people who learn nothing and forget nothing. Such people will doubtless keep on prattling about the pre-Adamite destruction of the world which they imagine to have existed before our present set of plants and animlas; or they may even keep on repeating the outgrown twaddle of Pye Smith, Hugh Miller and Gladstone, by which these traditional "ages" are carefully matched up against the days of the first chapter of Genesis. *Requiescant in pace.*

In order that I may not be misunderstood, let me repeat what I have said so many times elsewhere. I do not affirm that the Deluge accounts for all the fossiliferous deposits. That would itself be too dogmatic. *The correct position is that modern scientific evidence compels us to believe in a great world-catastrophe of some sort and of quite undefinable dimensions; then, if we make a reasonable allowance for the work which this catastrophe probably accomplished, we shall not have enough fossils left over and unaccounted for to give us any ground for believing in any previous age of our earth back of the one which we commonly call the Antediluvian Age.*

This one Antediluvian Age is now an established fact. It was characterized by a marvellously mild and uniform climate, by a profusion of vegetation, by huge numbers of animals many of which are unknown to our modern forests and plains and oceans. It was (except for the sad presence of those intruders, suffering and death) very much the same kind of world which God had created for man in the beginning and which He had pronounced " very good."

This was the world which was overwhelmed by that great catastrophe mentioned in the seventh and eighth chapters of Genesis, which is also embodied in over a hundred separate traditions among the scattered races of mankind.

And the man who carefully thinks this matter through to its logical conclusion, in the light of all the scientific facts now available, will have no place left for any previous world-catastrophe before the beginning of the world of plants and animals mentioned in the first chapter of Genesis. Nor will he have any desire to repeat the hopeless task of trying to harmonize the days of Creation with these mythical geological " ages."

What about the days of Creation? Were they literal days?

In the light of all that we now know as revealed by modern science, I can only say that we have every reason to believe they were real, literal days, as we have them now. Why not? What conceivable scientific reason do we have for questioning this view of the matter? With the geological series of successive groups of plants and animals now telescoped into one age, what is left but a real Creation, as described in the Bible? And why may not this literal Creation be taken at its face value, just as recorded?

Natural science must never be expected to *prove the* *details* of such a Creation. Its only task is to remove false ideas which stand in the way of our believing in such a beginning of our earth and its inhabitants. This our modern scientific research is now doing very completely and very satisfactorily; and for this every devout Christian should be thankful. But he ought not to expect more than this.

This leaves him free to believe in a real Creation on the strength of a Divine Revelation. Why should any man ask for more than this?

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